

DRAFT

WATER QUALITY
AND
POLLUTION CONTROL
IN MICHIGAN
2014 SECTIONS 303(d), 305(b), AND 314
INTEGRATED REPORT



Michigan Department of Environmental Quality
Water Resources Division
December 2013

This Integrated Report is available electronically on the Michigan Department of Environmental Quality, Water Resources Division, Web site at <http://www.michigan.gov/deqwater> under Water Quality Monitoring, Assessment of Michigan Waters.

ACKNOWLEDGEMENTS

Appreciation is extended to contributing staff members of various Michigan Department of Environmental Quality divisions and the Great Lakes Environmental Center for their assistance in the development of this Integrated Report.

Chapter heading images for Chapters 3 and 8 were provided by David Kenyon, Michigan Department of Natural Resources. The Chapter heading image for Chapter 1 was provided by Dawn Roush, Michigan Department of Environmental Quality. The title page image and Chapter heading images for Chapters 5 and 7 were provided by William Taft, Michigan Department of Environmental Quality. The Chapter heading image for Chapter 6 was provided by Seth Wright, Great Lakes Environmental Center. Chapter heading images for Chapters 4 and 10 were provided by Matthew Wesener, Michigan Department of Environmental Quality. Chapter heading images for Chapters 2 and 9 were provided by Kevin Goodwin, Michigan Department of Environmental Quality.

Report Compiled by: Kevin Goodwin, Sam Noffke, and Jason Smith
Surface Water Assessment Section
Water Resources Division

TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	i
LIST OF TABLES.....	v
LIST OF FIGURES.....	vii
EXECUTIVE SUMMARY.....	x
CHAPTER 1.....	11
INTRODUCTION.....	11
1.1 PURPOSE.....	11
1.2 MICHIGAN’S WATERS.....	12
1.2.1 <i>Great Lakes, Bays, Connecting Channels, and Lake St. Clair</i>	13
1.2.2 <i>Inland Lakes and Reservoirs</i>	14
1.2.3 <i>Rivers</i>	20
1.2.4 <i>Wetlands</i>	21
CHAPTER 2.....	23
WATER PROTECTION.....	23
ACTIVITIES.....	23
2.1 ABANDONED WELL MANAGEMENT.....	23
2.2 AQUATIC NUISANCE CONTROL.....	24
2.3 BEACH PROTECTION.....	24
2.4 BIOSOLIDS.....	24
2.5 COASTAL MANAGEMENT.....	25
2.6 COMMUNITY WATER SUPPLY, SOURCE WATER ASSESSMENT, AND PROTECTION....	25
2.7 COMPLIANCE AND ENFORCEMENT.....	26
2.8 CONSERVATION RESERVE ENHANCEMENT PROGRAM.....	26
2.9 CONTAMINATED SEDIMENT.....	27
2.10 DRINKING WATER CONTAMINATION INVESTIGATION.....	27
2.11 ENVIRONMENTAL HEALTH.....	27
2.12 DRINKING WATER AND WASTEWATER INFRASTRUCTURE FINANCIAL ASSISTANCE ..	27
2.13 GREAT LAKES.....	28
2.14 GROUNDWATER DISCHARGE.....	30
2.15 INDUSTRIAL PRETREATMENT.....	30
2.16 INFRASTRUCTURE SECURITY.....	30
2.17 INLAND LAKES AND STREAMS.....	31
2.18 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM.....	31
2.19 NONPOINT SOURCE CONTROL.....	32
2.20 SEPTAGE.....	32
2.21 SOIL EROSION AND SEDIMENTATION CONTROL.....	33
2.22 WETLANDS PROTECTION.....	33
2.23 CLEAN WATER ACT SECTION 404 PERMIT PROGRAM.....	34
2.24 WATER PROTECTION SPECIAL INITIATIVES.....	35
2.24.1 <i>Aquatic Invasive Species</i>	35
2.24.2 <i>Saginaw Bay Coastal Initiative</i>	38
2.25 COST/BENEFIT ASSESSMENT.....	39
CHAPTER 3.....	40
WATER QUALITY MONITORING.....	40
CHAPTER 4.....	43
ASSESSMENT METHODOLOGY.....	43
4.1 INTRODUCTION.....	43
4.2 DATA AND INFORMATION USED TO DETERMINE DESIGNATED USE SUPPORT.....	43
4.3 DETERMINATION OF DESIGNATED USE SUPPORT.....	45
4.4 DESIGNATED USES: AGRICULTURE, NAVIGATION, AND INDUSTRIAL WATER SUPPLY	46
4.4.1 <i>Assessment Type: No Specific Indicator or Assessment Method</i> ...	46
4.5 DESIGNATED USE: WARMWATER FISHERY AND COLDWATER FISHERY.....	46
4.5.1 <i>Assessment Type: Physical/Chemical</i>	46

4.5.2	<i>Assessment Type: Biological</i>	48
4.6	DESIGNATED USE: OTHER INDIGENOUS AQUATIC LIFE AND WILDLIFE	49
4.6.1	<i>Assessment Type: Physical/Chemical</i>	49
4.6.2	<i>Assessment Type: Biological</i>	51
4.7	DESIGNATED USE: PARTIAL BODY CONTACT RECREATION AND TOTAL BODY CONTACT.....	53
	RECREATION	53
4.7.1	<i>Assessment Type: Pathogen Indicators</i>	53
4.8.1	<i>Assessment Type: Physical/Chemical</i>	56
4.8.2	<i>Assessment Type: Other Public Health Indicators</i>	59
4.9	DESIGNATED USE: PUBLIC WATER SUPPLY	60
4.9.1	<i>Assessment Type: Physical/Chemical</i>	60
4.10	ASSESSMENT UNITS AND DETERMINATION OF GEOGRAPHIC EXTENT	61
4.11	ASSESSMENT UNIT ASSIGNMENT TO CATEGORIES	62
4.12	IMPAIRMENT CAUSE AND SOURCE	64
4.13	DELISTING CATEGORY 5 ASSESSMENT UNITS	65
4.14	ASSESSMENT METHODOLOGY CHANGES	65
	CHAPTER 5	67
	ASSESSMENT RESULTS: THE GREAT LAKES, BAYS, CONNECTING CHANNELS (ST. MARYS, ST. CLAIR, AND DETROIT RIVERS), AND LAKE ST. CLAIR	67
5.1	TROPHIC STATUS	67
5.2	WATER CHEMISTRY OF THE GREAT LAKES CONNECTING CHANNELS	67
5.3	WATER CHEMISTRY OF SAGINAW BAY AND GRAND TRAVERSE BAY	68
5.4	FISH CONTAMINANTS.....	69
5.5	BEACHES.....	70
5.6	DECAYING ORGANIC MATTER DEPOSITS.....	71
5.7	DESIGNATED USE SUPPORT SUMMARY.....	71
	CHAPTER 6	76
	ASSESSMENT RESULTS:.....	76
	INLAND LAKES AND RESERVOIRS	76
6.1	TROPHIC STATUS	76
6.2	FISH CONTAMINANTS.....	76
6.3	BEACHES.....	77
6.4	DESIGNATED USE SUPPORT SUMMARY.....	78
	CHAPTER 7	80
	ASSESSMENT RESULTS: RIVERS	80
7.1	BIOLOGICAL INTEGRITY	80
7.2	WATER CHEMISTRY	81
7.3	FISH CONTAMINANTS.....	82
7.4	MICRO-ORGANISMS	83
7.5	DESIGNATED USE SUPPORT SUMMARY.....	83
	ASSESSMENT RESULTS: WETLANDS.....	96
8.1	DESIGNATED USE SUPPORT SUMMARY.....	96
	CHAPTER 9	98
	WATER BODIES NOT SUPPORTING DESIGNATED USES AND CWA SECTION 303(D) REQUIREMENTS	98
9.1	INTRODUCTION	98
9.2	IMPAIRMENT CAUSE AND SOURCE	98
9.2.1	<i>Great Lakes and Connecting Channels</i>	99
9.2.2	<i>Inland Lakes and Reservoirs</i>	100
9.2.3	<i>Rivers</i>	101
9.2.4	<i>Wetlands</i>	102
9.3	TMDL DEVELOPMENT	102
9.3.1	<i>The TMDL Process</i>	102
9.3.2	<i>TMDLs Completed</i>	103

9.3.3	<i>TMDL Schedule</i>	103
9.3.4	<i>Changes to the Section 303(d) List</i>	104
PUBLIC PARTICIPATION IN THE IR		107
10.1	INTRODUCTION	107
10.2	REQUEST FOR DATA	107
10.3	PUBLIC NOTICE OF DRAFT ASSESSMENT METHODOLOGY	107
10.4	PUBLIC NOTICE OF THE DRAFT IR	107
Literature Cited		108

LIST OF TABLES

Table 1.1	Michigan Atlas	13
Table 1.2	Jurisdictional Control of the Four Great Lakes Bordered by Michigan	14
Table 1.3	Michigan's Public Access Lakes and Cisco Lakes by County.....	16
Table 4.1	Carlson's TSI Equations.....	51
Table 4.2	Michigan Inland Lakes Trophic Status Classification Criteria	51
Table 4.3	Overall Fish Consumption Designated Use Support Determination for Mercury Using Water Column and Fish Tissue Mercury Concentration	59
Table 4.4	Examples of Assessment Unit Assignment to Categories Using a Multiple Category System With Three Designated Uses	64
Table 5.1	Trophic Status of the Great Lakes Bordering Michigan	67
Table 5.2	Designated Use Support Summary for the Great Lakes, Bays, and Lake St. Clair	74
Table 5.3	Designated Use Support Summary for the Great Lakes Connecting Channels in Michigan.....	75
Table 6.1	Trophic Status Summary of Michigan's Public Access Lakes.....	76
Table 6.2	Designated Use Support Summary for Inland Lakes and Reservoirs in Michigan.....	79
Table 7.1	Proportion of River Miles Supporting the Other Indigenous Aquatic Life and Wildlife Designated Use	80
Table 7.2	Designated Use Support Summary for Rivers in Michigan	86
Table 8.1	Designated Use Support Summary for Michigan Wetlands	97
Table 9.1	Michigan Great Lakes and Bays Not Supporting Designated Uses Listed by Cause of Impairment.....	99
Table 9.2	Michigan Great Lakes and Bays Not Supporting Designated Uses Listed by Source of Impairment.....	99
Table 9.3	Michigan Connecting Channel River Miles Not Supporting Designated Uses Listed by Cause of Impairment.....	99
Table 9.4	Michigan Connecting River Miles Not Supporting Designated Uses Listed by Source of Impairment	99
Table 9.5	Michigan Inland Lake and Reservoir Acres Not Supporting Designated Uses Listed by Cause of Impairment.....	100

Table 9.6	Michigan Inland Lake and Reservoir Acres Not Supporting Designated Uses Listed by Source of Impairment.....	100
Table 9.7	Michigan River and Stream Miles Not Supporting Designated Uses Listed by Cause of Impairment.....	101
Table 9.8	Michigan River and Stream Miles Not Supporting Designated Uses Listed by Source of Impairment	101
Table 9.9	Michigan Wetland Acres Not Supporting Designated Uses Listed by Cause of Impairment.....	102
Table 9.10	Michigan Wetland Acres Not Supporting Designated Uses Listed by Source of Impairment.....	102
Table 9.11	Number of Assessment Units with TMDLs Completed and Approved in 2012	103

LIST OF FIGURES

Figure 1.1	Ecoregions of Michigan.....	20
Figure 2.1	Great Lakes Areas of Concern.....	29
Figure 3.1	Five-Year Rotating Watershed Cycle	42
Figure 4.1	Determination of Other Indigenous Aquatic Life and Wildlife Designated use Support Using Water Column Toxic Substance Concentration.....	50
Figure 4.2a	Determination of Partial Body Contact and Total Body Contact Designated Use Support Using Ambient <i>E. coli</i> Water Column Concentration for Michigan beaches	54
Figure 4.2b	Determination of partial body contact and total body contact designated use support using ambient <i>E. coli</i> water column concentration for Michigan streams and rivers (non-beaches)	55
Figure 4.3	Determination of Fish Consumption Designated Use Support Using Water Column Mercury Concentration.....	57
Figure 4.4	Determination of Fish Consumption Designated Use Support Using Fish Tissue Mercury Concentration.....	58
Figure 7.1	Fish Consumption Designated Use Support Summary for Michigan Rivers	87
Figure 7.2	Rivers Not Supporting the Fish Consumption Designated Use Based on Mercury in Fish Tissue.....	88
Figure 7.3	Rivers Not Supporting the Fish Consumption Designated Use Based on Mercury in Water Column	89
Figure 7.4	Rivers Not Supporting the Fish Consumption Designated Use Based on PCB in Fish Tissue	90
Figure 7.5	Rivers Not Supporting the Fish Consumption Designated Use Based on PCB in Water Column.....	91
Figure 7.6	Other Indigenous Aquatic Life and Wildlife Designated Use Support Summary for Michigan Rivers	92
Figure 7.7	Rivers Not Supporting the Other Indigenous Aquatic Life and Wildlife Designated Use Based on Habitat Alterations	93
Figure 7.8	Rivers Not Supporting the Other Indigenous Aquatic Life and Wildlife Designated Use Based on Mercury in Water Column	94
Figure 7.9	Rivers Not Supporting the Other Indigenous Aquatic Life and Wildlife Designated Use Based on PCB in Water Column.....	95
Figure 9.1	Section 303(d) Delistings	105
Figure 9.2	Section 303(d) New Listings	106

LIST OF APPENDICES

Appendix A1. Maps of 8-digit and 12-digit HUCs in Michigan-Lower Peninsula.

Appendix A2. Maps of 8-digit and 12-digit HUCs in Michigan-Upper Peninsula.

Appendix B. Comprehensive list of assessment unit designated use support.

Appendix C. TMDL groups.

Appendix D1. Section 303(d) list modifications-delistings.

Appendix D2. Section 303(d) list modifications-new listings.

Appendix E. Public comments.

Due to the extensive number of pages contained in these documents, all appendices are available electronically at <http://www.michigan.gov/deqwater> under Water Quality Monitoring, Assessment of Michigan Waters, Water Quality and Pollution Control in Michigan Sections 303(d), 305(b), and 314 Integrated Report.

LIST OF ACRONYMS

ADB	Assessment Database
AIS	Aquatic Invasive Species
AOC	Areas of Concern
BCC	Bioaccumulative Chemicals of Concern
BEACH Act	Beaches Environmental Assessment and Coastal Health Act of 2000
BPJ	Best Professional Judgment
CAZ	Critical Assessment Zone
CMI	Clean Michigan Initiative
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
DDT	Dichlorodiphenyltrichloroethane
GIS	Geographic Information System
GLEC	Great Lakes Environmental Center
HCV	Human Cancer Value
HNV	Human Noncancer Value
HUC	Hydrologic Unit Codes
IBI	Indices of Biological Integrity
IR	Integrated Report
LaMP	Lakewide Action Management Plan
LHD	Local Health Department
MDARD	Michigan Department of Agriculture & Rural Development
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality
MDNR	Michigan Department of Natural Resources
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MiRAM	Michigan Rapid Assessment Method
MS4	Municipal Separate Storm Sewer System
NHD	National Hydrography Dataset
ng/L	Nanograms per liter
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NREPA	Natural Resources and Environmental Protection Act
NWCA	National Wetland Condition Assessment
P51	Procedure 51
PBB	Polybrominated Biphenyl
PCB	Polychlorinated Biphenyl
SWQIF	Strategic Water Quality Initiatives Fund
TMDL	Total Maximum Daily Load
TSI	Trophic Status Index
USEPA	United States Environmental Protection Agency
ug/L	Micrograms per liter
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WCMP	Water Chemistry Monitoring Project
WMP	Watershed Management Plan
WQS	Water Quality Standards
WRD	Water Resources Division

EXECUTIVE SUMMARY

The federal Water Pollution Control Act (PL 92-500), also known as the Clean Water Act (CWA), requires states to provide the United States Environmental Protection Agency (USEPA) with an assessment of the quality of their waters [Section 305(b)], a list of waters that do not support their designated uses or attain Water Quality Standards (WQS) and require the development of Total Maximum Daily Loads (TMDLs) [Section 303(d)], and an assessment of status and trends of publicly owned lakes (Section 314). Similar to the 2012 reporting cycle, the Michigan Department of Environmental Quality (MDEQ) is fulfilling these CWA reporting requirements in 2014 through the submission of an Integrated Report (IR).

A primary objective of this IR is to describe attainment status of Michigan's surface waters relative to the designated uses specified in Michigan's WQS. Michigan's WQS are consistent with the Great Lakes Initiative, establish minimum water quality requirements by which the waters of the state are to be managed, and provide the primary framework that guides the MDEQ's water quality monitoring/assessment and water protection activities. To describe the attainment status of surface waters, each water body is placed in at least one of five reporting categories based upon the degree of designated use support, the amount of information known about the water body's water quality status, and the type of impairment preventing designated use support.

This IR includes a description of the scope of Michigan waters covered; a summary of MDEQ activities designed to protect and restore water quality; an overview of water quality monitoring in Michigan; a description of Michigan's current assessment methodology; summaries of monitoring results and designated use support in the Great Lakes (including connecting channels and bays), inland lakes and reservoirs, rivers, and wetlands; information regarding water bodies not supporting designated uses, including water bodies requiring the development of a TMDL [i.e., Section 303(d) listings]; and a summary of the public participation process used in the development of this IR.

With the biennial development of each Section 305(b) report, Section 303(d) report, or IR, Michigan continues to refine its data management and assessment methodology. Implementation of data management and assessment methodology changes initiated for the 2012 IR continued in the preparation of this IR. These changes continue to advance Michigan's mapping and display capabilities for Section 305(b) and Section 303(d) listings. As a result, listing information in the form of maps became available to the public in December 2009 via the Michigan Surface Water Information Management System (MiSWIMS) <http://www.michigan.gov/miswims>, which has recently been updated and now contains enhancements like access to use-specific comments within the Assessment Database (ADB). The MiSWIMS serves as a valuable resource for those interested in additional detail in any specific listing decision throughout the state.

Detailed lists of designated use support are contained in this report (Appendix B) as well as designated use support summaries for Great Lakes (including connecting channels and bays), inland lakes and reservoirs, rivers, and wetlands (Tables 5.2, 5.3, 6.2, 7.2, and 8.1, respectively). Overall, many of Michigan's surface waters are impacted by polychlorinated biphenyls (PCBs) and mercury and consequently do not support the other indigenous aquatic life and wildlife designated use and/or the fish consumption designated use. Atmospheric deposition is considered to be the major source of these persistent bioaccumulative chemicals. Excluding PCBs and mercury, physical/chemical and biological assessments of inland lakes and rivers indicate designated uses are supported in a majority of water bodies.

CHAPTER 1 INTRODUCTION

1.1 Purpose

The federal Water Pollution Control Act (PL 92-500), also known as the CWA, requires states to provide the USEPA with an assessment of the quality of their waters [Section 305(b)], a list of waters that do not support their designated uses or attain WQS and require the development of TMDLs [Section 303(d)], and an assessment of status and trends of publicly owned lakes

(Section 314). Similar to the 2012 reporting cycle, the MDEQ is fulfilling these CWA reporting requirements in 2014 through the submission of an IR. Where possible, Michigan's 2014 IR was developed consistent with the USEPA's "Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act" and supplemental guidance information for 2008, 2010, 2012, and 2014 IRs prepared by the USEPA.

A primary objective of this IR is to describe attainment status of Michigan's surface waters relative to the designated uses specified in Michigan's WQS (available at http://www.michigan.gov/documents/deq/wb-swqs-rules-part4_254149_7.pdf). Michigan's Part 4 Rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). Michigan's WQS are consistent with the Great Lakes Initiative, establish minimum water quality requirements by which the waters of the state are to be managed, and provide the primary regulatory framework that guides the MDEQ's water quality monitoring/assessment and water protection activities. To describe the attainment status of surface waters, each water body is placed in at least one of five reporting categories (see Section 4.11) based upon the degree of designated use support, the amount of information known about the water body's water quality status, and the type of impairment preventing designated use support. Additionally, the attainment status information described within this IR is used to help inform some of the outcomes associated with various goals identified within the Water Resources Division's (WRD) Measures of Success. The Measures of Success are used to define the expected outcomes of water resource program issues geared toward having clean and safe water (http://www.michigan.gov/deq/0,1607,7-135-3306_28610---,00.html).

The remainder of this chapter includes a description of the scope of Michigan waters covered in this IR. Chapter 2 summarizes MDEQ programs designed to protect and restore water quality. Chapter 3 contains an overview of water quality monitoring in Michigan. Chapter 4 details Michigan's current assessment methodology. Chapters 5, 6, 7, and 8 are more technical in nature and provide summaries of monitoring results and designated use support in the Great Lakes (including connecting channels and bays), inland lakes, rivers, and wetlands, respectively. Chapter 9 addresses all water body types not supporting designated uses, including water bodies requiring the development of a TMDL [i.e., Section 303(d) listings]. Chapter 10 includes information regarding the public participation process in the development of this IR.



Data Management and Assessment Methodology Updates

With the biennial development of each Section 305(b) report, Section 303(d) report, or IR, Michigan continues to refine its data management and assessment methodology.

Michigan underwent extensive data management and assessment methodology changes to prepare the 2008 IR. All data (i.e., records) were transferred from the Michigan developed Water Body System to the USEPA Assessment Database (ADB).. Use of the ADB makes Michigan's IR listings compatible with the USEPA's national reporting system. During this database migration, records were georeferenced using the National Hydrography Dataset (NHD) and renamed using a 12-digit hydrologic unit code (HUC)-based naming convention. Michigan's assessment methodology underwent extensive revisions to ensure that all relevant designated uses were evaluated for all water bodies. A few changes were also made regarding data interpretation, which are explained in the 2008 IR.

The data management and assessment methodology changes implemented in the 2008 and 2010 IRs advanced Michigan's mapping capabilities for Section 305(b) and Section 303(d) listings. Listing information in the form of maps are available to the public via the MiSWIMS <http://www.michigan.gov/miswims>. The MiSWIMS is an interactive application that allows users to view and download surface water-related data and information collected by the MDEQ and Michigan Department of Natural Resources (MDNR).

Due to data management and assessment methodology changes, designated use support summary tables (e.g., Tables 5.2, 5.3, 6.2, 7.2, and 8.1) are not directly comparable to previous IRs. Similar to previous IRs, trends in designated use support are not discussed in this IR. Analysis of designated use support trends based on information presented in this and previous reports (e.g., change in number of river miles supporting designated uses) would be misleading. As assessment coverage increases and water bodies are evaluated for the first time or when more sophisticated and sensitive monitoring techniques are applied (e.g., low level PCB analysis), the proportion of supporting versus not supporting water bodies will change between reporting cycles. However, such a proportion change between reporting cycles may not constitute a real overall change in water quality.

1.2 Michigan's Waters

Michigan is blessed with a wealth of surface water resources, including Great Lakes and their connecting channels, inland lakes, rivers, and wetlands (Table 1.1). Most of Michigan also has an abundant supply of high quality groundwater.

In general, the open waters of the Great Lakes have good to excellent water quality. The inland waters of Michigan's Upper Peninsula and the northern half of the Lower Peninsula support diverse aquatic communities and are commonly found to have good to excellent water quality. Many lakes and rivers in this mostly forested area of the state support coldwater fish populations. Lakes and rivers in the southern half of Michigan's Lower Peninsula generally have good water quality and support warmwater biological communities as well as some coldwater fish populations. The southern portion of the state contains Michigan's major urban areas with much of the rural land in agricultural production. Many of Michigan's rivers and lakes receive direct discharge of treated effluent from municipal and industrial sources as well as

runoff from urbanized areas, construction sites, and agricultural areas. Sedimentation, nutrient enrichment, and toxic pollutant loading are problems associated with runoff that can impact surface water quality. Surface water quality is generally showing improvement where programs are in place to correct problems and restore water quality.

Table 1.1 Michigan Atlas (all values are approximations).

Topic	Number	Area	Length	Source
State population	9.9 million			United States Census Bureau 2010 Estimate
State surface area		96,760 mi²		Sommers, 1977
Great Lakes, Great Lakes bays, and Lake St. Clair		42,167 mi² (~45% of total Great Lakes area)		USGS NHD (1:24,000 scale)
Inland lakes and reservoirs with surface area ≥ 0.1 acre	46,000	872,109 acres		USGS NHD (1:24,000 scale)
Rivers and streams (including connecting channels)			76,439 mi	USGS NHD (1:24,000 scale)
Wetlands		5,583,400 acres		USFWS National Wetland Inventory

1.2.1 Great Lakes, Bays, Connecting Channels, and Lake St. Clair

The Great Lakes contain 20 percent of the world's fresh surface water and are a unique natural resource. The protection of the Great Lakes is shared by the United States and Canadian federal governments; the states of Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, and New York; and the Canadian Provinces of Ontario and Quebec. Various Native American tribal organizations are also stakeholders and play a role in protecting Great Lakes water quality.

Michigan lies almost entirely within the watersheds of Lakes Superior, Michigan, Huron, and Erie (Table 1.2). The state maintains jurisdiction over approximately 45 percent (by surface area) of the 4 bordering Great Lakes (38,865 of a total area of 86,910 square miles). Significant Great Lakes bays include Grand Traverse Bay and Saginaw Bay. In this IR, the St. Marys, St. Clair, and Detroit Rivers (connecting channels) and Lake St. Clair are generally discussed in the Great Lakes Chapter (see Chapter 5). The term "connecting channels" used in this report is slightly different than the term "connecting waters" defined in Michigan's WQS. In this IR, the Keweenaw waterway (i.e., the Portage Lake ship canal, Portage Lake, Portage River, etc.) is reported as river miles and inland lakes. Michigan's WQS include the Keweenaw waterway in the "connecting waters" definition.

Generally, the open waters of the upper Great Lakes (Superior, Michigan, and Huron) have excellent water quality. Exceptions include a few impaired locations restricted to nearshore zones influenced by large, densely populated, and heavily industrialized areas. Great Lakes' water quality has benefited from pollutant control and remedial efforts in tributaries. These activities have reduced the discharge of conventional and toxic pollutants, including nutrients, persistent organic compounds, metals, and oils.

Table 1.2 Jurisdictional control of the four Great Lakes bordered by Michigan.

Great Lake	Canadian* (miles ²)	United States* (miles ²)	Michigan† (miles ²)	Total* (miles ²)
Superior	11,100	20,600	16,400	31,700
Michigan	---	22,300	13,250	22,300
Huron	13,900	9,100	9,100	23,000
Erie	4,930	4,980	115	9,910
Total	29,930	56,980	38,865	86,910

*Strum, 2000; †United States Census Bureau 2002 estimate

Aquatic Invasive Species (AIS) continue to have dramatic indirect and direct effects on the Great Lakes (see Section 2.25.1). AIS are responsible for increases in water clarity, loss of organisms and biodiversity, disruption of food webs, and impacts on economically important fish species (International Association for Great Lakes Research, 2002). Emerging research also shows that AIS cause changes in nutrient cycling and availability and may contribute to increased plant and algae growth in many nearshore areas, such as Saginaw Bay and the western basin of Lake Erie.

The Great Lakes have problems with selected persistent bioaccumulative chemicals. Fish consumption advisories in the Great Lakes serve as reminders that certain pollutants, such as PCBs, chlordane, dioxins, and mercury remain elevated in the water column and fish tissue. The use of PCBs and dichlorodiphenyltrichloroethane (DDT) was banned in the 1970s and concentrations of these chemicals in Great Lakes fish have declined; however, concentrations in some species still require consumption advisories. Atmospheric deposition, tributary loadings, and the dynamic exchange and cycling between air, water, and sediment within the Great Lakes basins are the key factors influencing contaminant levels in Great Lakes fish.

1.2.2 Inland Lakes and Reservoirs

Michigan has approximately 46,000 inland lakes (including lakes, ponds, and river impoundments) with a surface area of at least one-tenth of an acre or greater. Lakes with the largest surface area include Houghton (Roscommon County), Torch (Antrim and Kalkaska Counties), Charlevoix (Charlevoix County), Burt (Cheboygan County), Mullett (Cheboygan County), Gogebic (Gogebic and Ontonagon Counties), Manistique (Luce and Mackinac Counties), Black (Cheboygan and Presque Isle Counties), Crystal (Benzie County), Portage (Houghton County), and Higgins (Crawford and Roscommon Counties).

Michigan has 730 inland lakes that are deemed “public access lakes” (Table 1.3). The list of public access lakes includes lakes with a public boat launch and a lake surface area of at least 50 acres as well as a few recreationally important small lakes (less than 50 acres) that have public boat launches. There are 345 public access lakes located in the southern Lower Peninsula, 219 in the northern Lower Peninsula, and 166 in the Upper Peninsula. The average public access lake size is 341 acres in the southern Lower Peninsula, 1,342 acres in the northern Lower Peninsula, and 731 acres in the Upper Peninsula.

Michigan has 156 inland lakes that are deemed “cisco lakes.” The cisco (*Coregonus artedii*) is a member of a trout and salmon (Salmonidae) subfamily that usually occupies the cooler and deeper niches of high quality freshwater inland lakes and many parts of the Great Lakes. In North America, cisco can be found from Alaska to New England. Ciscos are, or were, present in at least 156 lakes in 41 Michigan counties ranging from the Indiana border to Keweenaw

County in the Upper Peninsula. The cisco is currently identified as a state threatened species pursuant to the NREPA. Ciscos require relatively deep inland lakes with cool, well-oxygenated waters. During summer stratification, cisco are rarely found in waters above 20°C or at dissolved oxygen concentrations less than 3.0 parts per million. This species is very sensitive to habitat degradation and has been extirpated from lakes where these minimum thermal and dissolved oxygen conditions are not met. In 2003, the MDNR initiated a study to assess the status of the cisco populations in Michigan. The intent of this ongoing study is to identify inland lakes in which populations are extant and increase awareness of this species so that protective Best Management Practices are promoted.

Although Michigan's inland lakes generally have good to excellent water quality, some water quality issues remain. Of the public access lakes that do not meet WQS, the primary cause is fish consumption advisories for PCBs or mercury. A statewide mercury-based fish consumption advisory applies to all of Michigan's inland lakes, reservoirs, and impoundments. The majority of Michigan's public access lakes have moderate or low nutrient levels; however, nutrient levels are high enough in several lakes to warrant corrective action through the development and implementation of a TMDL. Many lakes with moderate to high nutrient levels are located in the southern Lower Peninsula where large population centers and fertile soils exist. Many lakes with low nutrient levels are located in the northern Lower Peninsula and Upper Peninsula where the population density is lower, soils are less fertile, and lakes tend to be larger and deeper. Contaminated sediments are also an issue in several inland lakes, and remediation efforts are being planned or have been undertaken.

Table 1.3 Michigan's public access and cisco lakes by county. *Indicates that the lake is a public access lake and a cisco lake. †Indicates that the lake is a cisco lake only.

ALCONA Alcona Dam Pond Brownlee Cedar Crooked Hubbard* Jewell North Vaughn ALGER AuTrain Basin AuTrain Lake Deer† Fish Grand Sable Kingston Nawakwa ALLEGAN Allegan Baseline Big Duck Eagle Green* Hutchins Kalamazoo Lower Scott Miner Osterhout Selkirk Swan Swan Creek Pond ALPENA Beaver* Fletcher Pond ANTRIM Bellaire* Benway Birch Clam Elk* Ellsworth Intermediate* Lake of the Woods St. Clair Torch* Wilson BARAGA Beaufort Big Keewaydin King Parent Prickett Dam Ruth Vermilac	BARRY Baker Barlow† Big Cedar† Bristol Carter Chief Noonday Clear Cloverdale Crooked Deep Duncan Fine Fish* Gun Jordan Leach Lime† Little Cedar† Long (Hope Twp) Long (Johnstown Twp)* Long (Yankee Springs Twp) Lower Crooked Middle Payne Pine Thornapple BENZIE Ann* Betsie Crystal* Herendeene Little Platte Lower Herring Pearl Platte Stevens Turtle Upper Herring BERRIEN Paw Paw BRANCH Archer* Bartholomew† Cary Coldwater* Craig East Long* George Gilead Kenyon Lavine Marble* Matteson Morrison North Oliverda Randall Rose (Lake of the Woods) Silver South Union	CALHOUN Duck Goguac Homer Lane Lee Nottawa Prairie Upper Brace Wabascon Warner's Winnipeg CASS Baldwin* Belas Birch* Bunker† Chain† Christiana Curtis† Day† Dewey Diamond Donnell* Driskels Fish Harwood* Hemlock Indiana† Juno/Painter Kirk* Lewis† Lime† Magician Mill North Twin Paradise Round† Shavehead* South Twin Stone Tharp† CHARLEVOIX Charlevoix* Deer Hoffman Six Mile Susan Thumb Walloon* CHEBOYGAN Black Burt* Douglas† Lancaster Long Mullett* Silver Twin Central† Twin North† Twin South†	CHIPPEWA Caribou Carp Frenchmans Hulbert† Monacle* Shelldrake Impoundment CLARE Arnold Big Long Budd Cranberry Crooked Five George Lily Little Long Mud Perch Shingle Silver Windover CLINTON Ovid Park CRAWFORD Jones K.P. Margrethe Section One Shupac DELTA Boney Falls Camp 7 Corner Dana Pole Creek Lake Round Skeels DICKINSON Antoine Bass Carney Edey Hamilton Louise† Mary* Norway Pickeral Rock Sawyer Silver Six Mile EATON Narrow Saubee†
--	---	--	---

Table 1.3 continued. Michigan's public access and cisco lakes by county. *Indicates that the lake is a public access lake and a cisco lake. †Indicates that the lake is a cisco lake only.

EMMET Crooked Larks Paradise Pickeral Round GENESEE C.S. Mott Impoundment Fenton Holloway Reservoir Kearsley Reservoir Lobdell* Ponemah Thread GLADWIN Lake Four Pratt Secord Impoundment Wiggins Wixom Impoundment GOGEBIC Allen Bass Beatons Bobcat Chaney Cisco* Clark* Clearwater Crooked† Dinner Duck Eel Gogebic* Henry Impoundment Lac Vieux Desert Loon† Langford Little Oxbow Lake Pomeroy Marion McDonald GOGEBIC cont'd Moon Moosehead Moraine Noorwood† Ormes Sunday Taylor* Thousand Island*	GRAND TRAVERSE Arbutus Bass Bass Boardman Bridge† Brown Bridge Pond Cedar Cedar Hedge* Dubonnet Duck* Fife Green* Long Silver Spider HILLSDALE Baw Beese Bear* Bird Carpenter† Cub Diane Hemlock* Long (Reading Twp)* Long (Stubin Co., IN) Round Sand North† Sand Middle† Sand South† Wilson† HOUGHTON Bob Boston Emily Otter* Pike Portage* Rice Roland Sandy Torch* INGHAM Lansing IONIA Long Morrison Sessions Woodard	IOSCO Floyd Foote Dam Pond Indian Londo Long Loon* Loud Dam Pond Round Sand Tawas VanEtten West Londo IRON Bass Brule Buck Cable Camp Chicagon Deer Ellen Emily Fire First Fortune Gibson Golden Hagerman Hannah Webb Indian Iron James Kidney Little Smoky Long Mary Michigamme Norway Ottawa Perch Runkle Smoky* Stager Stanley Sunset Swan Tamarack Tepee Winslow ISABELLA Coldwater* Halls Littlefield* Stevenson	JACKSON Brown† Center Clark Crispell Gillets Grass Pleasant Portage Round South Lime Swain's* Vandercook* Vineyard Wampler's KALAMAZOO Austin Barton Crooked† Eagle Eagle Gourdneck Gull* Hogsett Howard† Indian* Long Morrow Pond Paw Paw* Portage (Blue) Ruppert Sagmaw† Sherman Sugarloaf West Whitford KALKASKA Bear Blue (Big)* Big Guernsey Cub East Indian Manistee North Blue† Pickeral Starvation Skegmog* Twin (Big)*
--	---	---	--

Table 1.3 continued. Michigan's public access and cisco lakes by county. *Indicates that the lake is a public access lake and a cisco lake. †Indicates that the lake is a cisco lake only.

KENT Bass Big Myers Big Pine Island Big Wabasis Camp Campau Campbell Lime Lincoln Murray* Pratt Reeds Ziegenfuss†	LIVINGSTON Appleton* Baseline* Bass† Bennett† Bishop Chemung* Fish† East Crooked* Hiland Limekiln† Ore† Portage† Runyan† Sandy Bottom† Thompson West Crooked* Whitmore Woodland Zukey†	MARQUETTE Anderson Ann† Arfelin Bass Bass Big Shag Dead River Storage Basin Engmans Greenwood Reservoir Horseshoe Independence* Ives† Johnson Little Little Shag Michigamme McClure Storage Reservoir Mountain† Pike Pine† Rush† Silver† Sporley* Squaw Witch Wolf	MISSAUKEE Crooked Goose Long Missaukee Sapphire
KEWEENAW Bailey Desor† Fanny Hoe* Gratiot Lac LaBelle Medora Ritchie† Sargent† Siskiwit† Thayer's	LUCE Bass Bodi Culhane Kaks Muskallonge North Manistique* Perch Pike Twin	MASON Bass Ford Gun Hackert (Crystal) Hamlin Lincoln Pere Marquette Pliness Round	MONTCALM Baldwin Bass Clifford Cowden Crystal Derby Dickerson Halfmoon Horseshoe Little Whitefish Loon Montcalm Mud Muskellunge Nevins Rainbow Rock Tamarack Townline Whitefish Winfield
LAKE Big Bass Big Star Harper Idlewild Little Bass† Paradise Reed Wolf	MACKINAC Brevoort* Little Brevoort Manistique* Milakokia Milicoquins S. Manistique*	MECOSTA Bergess Blue Chippewa Clear Hillsview Horsehead Jehnsen Martiny Mecosta Merrill Pretty Rogers Pond Round School Section Townline	MONTMORENCY Atlanta Avalon* Avery Clear East Twin Ess Gaylanta Grass Lake Fifteen Long* McCormick Muskellunge Rush Sage West Twin
LAPEER Big Fish Davidson Long Minnewanna Nepessing Otter	MACOMB Stony Creek Impoundment		
LEELANAU Cedar Davis Glen* Lime Little Glen Little Traverse* North Lk Leelanau* School South Lk Leelanau*	MANISTEE Arcadia Bear Canfield Healy Manistee Pine* Portage	MENOMINEE Long	MUSKEGON Bear Big Blue Duck East Twin Fox Half-Moon Mona Muskegon North White Wolf
LENAWEE Allens Deep Devils Hudson Round Round Sand		MIDLAND Sanford	

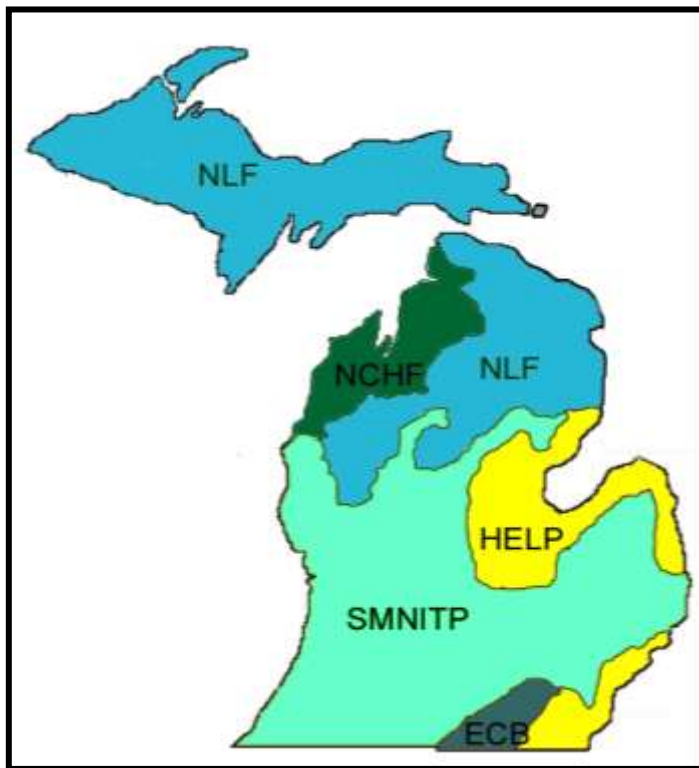
Table 1.3 continued. Michigan's public access and cisco lakes by county. *Indicates that the lake is a public access lake and a cisco lake. †Indicates that the lake is a cisco lake only.

NEWAYGO Baptist Benton Bills Blanch Brooks Croton Dam Pond Crystal Diamond Englewright Fremont Hardy Hess Kimball* Nichols* Pettibone Pickerei* Robinson Sand Woodland OAKLAND Angelus† Big Cass* Cedar Island* Crescent Deer* Dickinson Dunham† Green† Hammond† Heron Kent Lakeville Long Loon* Lotus* Lower Pettibone Maceday* Middle Straits Oakland Orchard* Orion Oxbow† Pontiac Seven Silver† Squaw/Clear Tipsico Townsend† Union* Upper Proud Upper Pettibone† Valley White Wildwood Wolverine	OCEANA Crystal McLaren Pentwater Schoolsection Silver Stony OGEMAW Au Sable Bush Clear DeVoe* George Grousehaven* Hardwood Horseshoe Lake George Peach Rifle Sage Tee ONTONAGON Bond Falls County Line OSCEOLA Big Diamond Hicks Rose Sunrise Todd Wells OSCODA McCollum Mio Dam Pond Tea OTSEGO Big Big Bass Big Bear Bradford Dixon Emerald Heart Manuka Opal Otsego Pickerei Twenty Seven OTTAWA Crockery Macatawa Pigeon Spring	PRESQUE ISLE Big Tomahawk Emma Essau Grand Long Lost May Nettie Shoepac Sunken ROSCOMMON Higgins* Houghton St. Helen SCHOOLCRAFT Boot Colwell Dodge Gemini Gulliver* Indian* Island Kennedy McDonald Petes Ross Snyder ST JOSEPH Big Fish Clear Corey* Crotch Fisher's Klinger* Long Long Palmer Pleasant* Portage Prairie River* Sand Sturgeon Tamarack† Thompson* Three Rivers Impoundment TUSCOLA Caro Reservoir Murphy North	VAN BUREN Ackley Banks Brandywine Cedar Clear Cora Eagle Eleven Fish Fourteen Gravel Halls Huzzy's Lake of the Woods Maple North Scott Round Rush Saddle School Section Shafer South Scott Three Legged Three Mile Upper Jephtha Upper Reynolds VanAuken Wolf† WASHTENAW Big Portage Blind† Bruin* Cedar Crooked Ford Four Mile Green Half Moon* Joslin Mill Mud North Pickerei† South* Sugar Loaf Winnewanna WAYNE Belleville Newburgh WEXFORD Berry Cadillac Hodenpyl Dam Pond Long Mitchell
---	--	--	--

1.2.3 Rivers

Michigan's rivers can be grouped by the distinct ecoregions through which they flow. Each of the five ecoregions in Michigan consists of areas that exhibit relatively similar geological landform characteristics (Omernik and Gallant, 1988). Factors used to delineate ecoregions include climate, soils, vegetation, land slope, and land use. This framework provides information on the environmental characteristics that tend to occur within each ecoregion. In order by size (largest to smallest area), the five ecoregions in Michigan are Southern Michigan/Northern Indiana Till Plains, Northern Lakes and Forests, North Central Hardwood Forests, Huron-Erie Lake Plains, and Eastern Corn Belt Plains (Figure 1.1).

Rivers in the Northern Lakes and Forests and North Central Hardwood Forests ecoregions tend to support coldwater fish within at least a portion of their systems. These rivers commonly have relatively small watersheds, high relief topography, substantial groundwater inputs, and are naturally low in productivity. Most rivers in the Northern Lakes and Forests ecoregion are perennial, often originating from lakes or wetlands. Although relatively free of sediment, surface waters in this ecoregion often have a characteristic brownish color because of elevated concentrations of dissolved organic material, including tannins and lignins. In the North Central Hardwood Forests ecoregion, river flow is highly variable. Flow is entirely intermittent in some portions of the ecoregion and entirely perennial in other areas. These rivers typically drain soils with much poorer nutrient content than in bordering ecoregions to the south.



SMNITP - Southern Michigan/Northern Indiana Till Plains
NCHF - North Central Hardwood Forests
NLF - Northern Lakes and Forests
HELP - Huron-Erie Lake Plains
ECB - Eastern Corn Belt Plains

Figure 1.1 Ecoregions of Michigan (Level III) (adapted from Omernik and Gallant, 1988).

Rivers in the Southern Michigan/Northern Indiana Till Plains ecoregion are generally of good water quality in the headwaters. This ecoregion is drained predominantly by perennial rivers. Such rivers are typically sluggish and are bordered, often extensively, by wetland tracts. Drainage ditches and channelized rivers have been a common solution to assist drainage of areas that are too wet for settlement and agricultural needs.

Upland features related to poor soil drainage heavily influence the rivers in the Huron-Erie Lake Plains and Eastern Corn Belt Plains ecoregions. Broad and nearly level lake plain is crossed by beach ridges and low moraines, which has resulted in the formation of poorly drained soils. More than half of the rivers in the Huron-Erie Lake Plains ecoregion are intermittent, and river flows are commonly runoff-dependent. In addition to the construction of numerous drainage ditches, the headwaters of many rivers are extensively channelized for quicker drainage and to improve upland field conditions. About half of the rivers in the Eastern Corn Belt Plains ecoregion are perennial and many have been channelized to assist soil drainage. This ecoregion is almost entirely farmland, and river quality is influenced by increased soil and water runoff from agricultural land uses.

1.2.4 Wetlands

About 15 percent of Michigan's land area is wetland. Several inventories of wetlands in Michigan have been undertaken by different agencies. The two most utilized are the Part 303 State Wetland Inventory, and the US Fish and Wildlife Service' National Wetland Inventory (NWI). Sources of wetland loss include permitted activities; unpermitted activities (i.e., violations of Section 404 of the CWA and state law); activities that are exempt under state and federal law; the loss of small, isolated wetlands that are not under state or federal jurisdiction; natural processes (e.g., beaver activity); and indirect effects (e.g., alteration of drainage networks due to urbanization). Wetland acreage may increase for some of the same reasons (e.g., changes in drainage pathways). However, most wetland gains are attributed to voluntary wetland restoration projects, pond construction, and mitigation for permitted impacts.

Part 303, Wetlands Protection, of the NREPA requires the MDEQ to make a preliminary inventory of all wetlands in the state on a county-by-county basis. County wetland inventories are now completed for all 83 counties in the state, and have been made available to the public on the Internet at <http://www.michigan.gov/degwater> under Wetlands Protection, Wetland Inventory Maps or by submitting a request for a large-format print to the MDEQ, WRD. The county wetland inventories were produced by overlaying data from the following sources: the USFWS National Wetland Inventory maps (1978), Natural Resources Conservation Service soil survey maps, and Michigan Resource Information System land use/land cover maps. County wetland inventories are intended to be used as planning tools that provide potential and approximate locations of wetlands and some information regarding wetland condition, but are not intended to be used to determine the jurisdictional boundaries of wetland areas subject to regulation.

Estimates of wetland losses since European settlement range from 35 percent, based on the Michigan Natural Features Inventory presettlement inventory to 50 percent based on the United States Fish and Wildlife Service (USFWS) Status and Trends reporting. During 2006, the MDEQ, Wetlands, Lakes, and Streams Unit, then housed in the Land and Water Management Division (LWMD), partnered with Ducks Unlimited Great Lakes/Atlantic Regional Office to perform an update to the original National Wetland Inventory dataset that was completed in the late 1970s and early 1980s. The project updated the National Wetland Inventory dataset to the two most recent, statewide, aerial photography flights conducted in the state, that being the 1998 United States Geological Survey (USGS) Digital Ortho Quarter Quads data and the 2005 National Agriculture Imagery Program data. This effort resulted in three distinct temporal wetland inventories for the State from which to draw conclusions and analyze trends. The 1998

inventory shows a total loss of vegetated wetlands of 59,246 acres. The 2005 inventory shows a total loss of vegetated wetlands of 14,337 acres. Subtracting these losses from the original NWI total wetland acreage yields a total of 6,432,461 acres of wetland remaining in Michigan.

The Michigan Natural Features Inventory published a preliminary assessment entitled, "Wetland Trends in Michigan Since 1800" (Comer, 1996), based on a comparison of original land surveys conducted by the General Land Office from 1816 to 1856 and Michigan Resource Information System land use/land cover maps. This publication includes a county-by-county estimate of historical wetland types and losses since pre-European settlement. In addition, the pre-European settlement maps have been digitized and are available for review in a Geographic Information System (GIS).

The Great Lakes Coastal Wetlands Consortium has completed a GIS-based inventory of Great Lakes coastal wetlands in cooperation with the Great Lakes state and provinces. This inventory is available through the Consortium's Web site at <http://www.glc.org/wetlands>.

CHAPTER 2 WATER PROTECTION ACTIVITIES

The MDEQ has a number of programs designed to protect and restore water quality. These programs establish WQS, provide regulatory oversight for public water supplies, issue permits to regulate the discharge of industrial and municipal wastewaters, provide technical and financial assistance to reduce pollutant runoff, ensure compliance with state laws, and educate the public about water quality issues. This chapter provides descriptions of Michigan's water quality protection programs and highlights several special initiatives and costs/benefits.



2.1 Abandoned Well Management

Unplugged abandoned wells threaten the quality of drinking water obtained from privately owned and publicly owned drinking water supply wells. The Resource Management Division has implemented a comprehensive Abandoned Well Management Program to coordinate statewide abandoned well location and plugging activities. Plugging abandoned wells protects the groundwater source aquifers that are used by nearly one-half of Michigan's citizens for drinking water. The goal of the Abandoned Well Management Program is to identify and properly plug as many abandoned wells as possible.

The WRD also administers an Abandoned Well Management Grants Program that is funded by the Clean Michigan Initiative (CMI). Abandoned well management grants target and fund the location and plugging of abandoned wells in community public water supply wellhead protection areas.

The MDEQ conducts training and public education/outreach activities to raise the level of public awareness concerning the environmental and public health threats associated with unplugged abandoned wells. Groundwater protection seminars that include abandoned well-related topics are sponsored for general audiences. Technical training programs covering abandoned well plugging techniques and requirements are conducted for registered water well drilling contractors, local health department (LHD) staff members, environmental consultants, and other state of Michigan departments.

The Michigan Department of Agriculture & Rural Development (MDARD) administers a cost share grants program, the "Farm*A*Syst" Program that can pay up to 90 percent of the cost for plugging abandoned wells on agricultural lands.

LHDs enforce abandoned well plugging requirements through field inspections and review of abandoned well plugging records that are submitted by registered well drilling contractors and property owners. The WRD conducts compliance and enforcement actions in cooperation with the Office of Criminal Investigations, the Michigan Department of Attorney General, and LHDs. Many successful enforcement actions have been taken in recent years.

2.2 Aquatic Nuisance Control

The MDEQ has the authority, under Part 33, Aquatic Nuisance Control, and Part 31, Water Resources Protection, of the NREPA, to regulate the chemical control of nuisance aquatic plants, algae, and swimmer's itch. Each application for a permit must undergo a thorough review to assess the environmental impact to the water body and any human health and safety issues. A large majority of these treatments are carried out by commercial pesticide applicators licensed by the MDARD. The MDEQ works with the MDARD to assure those treatments and the applicators comply with the requirements of the permits and the pertinent laws. Program staff also review new chemical products proposed for use in Michigan waters, survey Michigan lakes to determine the composition of the native plant community and presence of exotic plant species, and seek to educate riparian property owners about the management of aquatic plants and a variety of related lake management issues.

2.3 Beach Protection

In Michigan, LHDs have jurisdiction to test and otherwise evaluate water quality at bathing beaches to determine whether the water is safe for swimming. The LHDs advise beach owners when beaches should be closed and the local health officer may petition the county circuit court to close a beach if needed. Beach monitoring results collected by the LHDs and swimming advisories are made available to the public by the LHDs via the MDEQ's statewide beach monitoring Web site at <http://www.deq.state.mi.us/beach>. Signs are posted at bathing beaches stating whether or not the beach has been tested for *E. coli*. Since 2000, the MDEQ has provided grants to LHDs to support and augment beach monitoring throughout Michigan. These grants are funded by a combination of state CMI bond money and federal Beaches Environmental Assessment and Coastal Health Act (BEACH Act) funds. The BEACH Act authorizes the USEPA to award program development and implementation grants to eligible states, territories, tribes, and local governments. These annual grants support microbiological monitoring of coastal recreation waters, including the Great Lakes, which are adjacent to beaches or similar points of access used by the public. BEACH Act grants also support development and implementation of programs to notify the public of the potential exposure to disease-causing microorganisms in coastal recreation waters.

2.4 Biosolids

The treatment of municipal wastewater generates a residual sewage sludge that may be disposed through incineration or landfilling or these materials can undergo additional stabilization to become biosolids. Recycling biosolids on the land has proven to be a safe and cost-effective alternative for wastewater treatment plants. Biosolids contain essential macro and micro nutrients and are an excellent source as a fertilizer or soil conditioner. The MDEQ encourages the use of biosolids to enhance agricultural and silvicultural production in Michigan and in some cases biosolids can be used for landscaping purposes. However, if biosolids are not properly handled, the potential exists that these materials could enter surface water or groundwater and degrade water quality. To prevent such problems, the land application of biosolids is a highly regulated activity.

Under the federal regulations contained in Title 40 of the Code of Federal Regulations (CFR), Part 503, Standards for the Use or Disposal of Sewage Sludge; and the Part 24 Rules, Land Application of Biosolids, of the NREPA, criteria for biosolids land application have been established. National Pollutant Discharge Elimination System (NPDES) and state groundwater discharge permits require management of biosolids and other residuals from wastewater treatment facilities. Permittees are required to develop and obtain MDEQ approval of a Residuals Management Program. The MDEQ has district staff dedicated to overseeing the

Biosolids Land Application Program by inspecting the facilities generating biosolids and the land application sites.

2.5 Coastal Management

The Michigan Coastal Zone Management Program is one of more than 30 state coastal programs established under the authority of the Federal Coastal Zone Management Act of 1972 (PL 92-583). The National Oceanic and Atmospheric Administration (NOAA) provides annual funding to these state programs for the protection, preservation, and restoration of coastal cultural and natural resources. Michigan's Coastal Zone Management Program was established as a networked program in 1978 with the central focus to improve administration of existing state shoreline statutes (e.g., Shorelands Act, Submerged Land Act, Sand Dunes Act); provide substantial technical and financial assistance to local units of governments for creative coastal projects; and to improve governmental coordination to reduce time delays, duplication, and conflicts in coastal management decision-making.

2.6 Community Water Supply, Source Water Assessment, and Protection

The MDEQ oversees approximately 1,390 community water systems that furnish drinking water year-round to residential populations of 25 or more, to ensure that the USEPA's minimum standards for safe drinking water and the requirements of the Michigan Safe Drinking Water Act, 1976 PA 399, as amended (Act 399), are met. In the last year for which data has been collected, over 99 percent of the population served by community water supplies in Michigan received drinking water meeting all health standards. Since 2005, the percentage of the population served by water systems meeting all standards has exceeded 96 percent annually.

Since 1998, the Drinking Water Revolving Loan Fund has provided \$758 million in low interest loans for 252 projects designed to prevent public health threats from occurring in community water supply systems.

The reauthorization of Act 399 requires federal guidance and defines state requirements for a Source Water Assessment Program. Act 399 requires the state to identify the areas that supply public tap water, inventory contaminants and assess source water susceptibility to contamination, and inform the public of the results. In 1998, the MDEQ convened a Source Water Assessment Program Advisory Committee composed of key stakeholders to assist with Source Water Assessment Program development. Michigan's Source Water Assessment Program was approved by the USEPA in October 1999.

Information on nearly 18,000 drinking water sources, serving approximately 10,600 noncommunity water systems and 1,250 community water systems, was collected over a 6-year period. Potential sources of contamination were inventoried, and susceptibility to contamination was determined. The completed Source Water Assessment Program Report and all data were transmitted to the USEPA in December 2004. The Source Water Assessment Program Report is available at <http://www.michigan.gov/degwater> under Drinking Water, Source Water Assessment. New sources undergo a source water assessment as they are approved. Currently, MDEQ is re-assessing all of the community water system sources and will report the susceptibility ratings back to the water suppliers. The MDEQ also continues to encourage surface water suppliers to plan and implement protection activities. To date, six communities have obtained state approval for their Source Water Intake Protection Program Plans.

The MDEQ's Wellhead Protection Program assists local communities that utilize groundwater for their municipal drinking water supply systems to protect their water source. A Wellhead Protection Plan minimizes the potential for contamination by identifying and protecting the area

that contributes water to municipal water supply wells. Such protection help avoids costly groundwater cleanups.

Funding for activities is available through a state Wellhead Protection grant program and is designed to assist communities in the development and implementation of a Wellhead Protection Program. The state grant program funds 50 percent of eligible activities while the other 50 percent is matched with local funds. Grant money is awarded each year to public water supply systems based on a scoring system that ranks communities of similar size. The MDEQ will also provide a 50 percent match in funding for the development and implementation of a surface water intake protection program. Funding will be available in fiscal year 2015 and prioritized by the susceptibility of the source as determined in the source water assessments.

2.7 Compliance and Enforcement

The MDEQ, WRD, Enforcement Unit and Field Operations Division staff are responsible for conducting compliance and enforcement actions taken by the WRD. Field Operations Division staff conducts compliance inspections to ensure they are following the requirements of state water pollution control statutes and rules, surface and groundwater discharge permits, and violations of administrative or judicial orders. Other compliance and enforcement activities include response and investigation of complaints and the follow-up of corrective actions.

Enforcement action may be used to bring the entity into compliance as quickly as possible, restore any natural resource damages caused by the violation, assess appropriate penalties, eliminate financial gain that may have been realized as a result of noncompliance, and drive improvements in water quality. Enforcement actions are generally progressive in nature. They include any number of possible actions, including issuance of notices of violation, preparation of final orders of abatement, settlement via administrative consent orders, or referrals to the Michigan Department of Attorney General for civil or criminal litigation. The Enforcement Unit serves as the WRD's liaison with the Michigan Department of Attorney General and also works with the USEPA and the United States Department of Justice on joint state/federal enforcement cases.

MDEQ staff collect effluent samples from NPDES facilities to evaluate compliance with permit limits. Additionally, the MDEQ conducts special studies to support water quality enforcement actions. These studies may include water, sediment, biological, and/or toxicity sampling, depending on the specific issue. Water quality monitoring in response to spills is also conducted. Monitoring activities to support enforcement actions are implemented as needed, and are always developed with input from Enforcement Unit and Field Operations Division staff.

2.8 Conservation Reserve Enhancement Program

The MDEQ works closely with the MDARD to implement the Conservation Reserve Enhancement Program, a federal-state-local conservation partnership designed to reduce significant environmental effects related to agriculture. The Conservation Reserve Enhancement Program is being implemented in four critical watersheds (Saginaw Bay, Macatawa River, River Raisin, and western Lake Erie basin) that have intense agricultural land use. The objectives of the program are to improve and protect water quality and to promote and enhance wildlife habitat by providing incentives to Michigan citizens for implementing conservation practices for a period of 15 years. Eligible conservation practices include grass plantings, filter strips, riparian buffer strips, field windbreaks, and wetland restoration. The MDEQ also supplied Section 319 and CMI funds for livestock exclusion, implementation of Natural Resources Conservation Service approved conservation practices, Conservation Reserve Enhancement Program technical assistance, and permanent conservation easements.

The program has enrolled nearly 74,000 acres of the 85,000 acre goal in the priority watersheds.

2.9 Contaminated Sediment

The Contaminated Sediment Program consists of activities to coordinate and implement remediation at sites of environmental contamination that impact water quality. Sites range from current incidents of spills or losses of pollutants due to accidents or poor facility operations, to historic incidents where pollutants have been in the environment for many years. Some of these sites impact surface waters directly. Others may impact surface waters by the movement of contaminated groundwater, through treatment and permitted discharge of contaminated groundwater, or through discharges of contaminated groundwater to treatment facilities. The MDEQ staff members investigate sites of environmental contamination, make recommendations regarding proposed site remediation and treatment, evaluate treatment proposals and pollutant discharges from remediation systems, and provide other technical and project management support as necessary. As part of the CMI, \$25 million was set aside for the investigation and remediation of contaminated sediments in Michigan lakes, rivers, and streams. Summaries of these projects are contained in the MDEQ's Consolidated Report (MDEQ, 2012).

2.10 Drinking Water Contamination Investigation

The MDEQ assists LHDs in drinking water quality/contamination investigations of known, potential, or suspected groundwater contamination. Technical assistance includes consultation, analytical support, toxicological assessment, well construction design, well permitting activities, and development of health advisories.

MDEQ staff is responsible for administering well replacement activities when drinking water wells are found to be contaminated through no fault of the well owner. Water supply alternatives include temporary provision of bottled water, temporary provision of treatment devices when the concentration of contaminants exceeds body contact advisory levels, construction of a permanent replacement well to a protected aquifer, or connection to community water, if available. Activities related to connection to community water may include construction of a basic community water system, extension of water main, or connection to an existing water main.

MDEQ staff administers the statewide drinking water monitoring program for water supplies located in areas of known groundwater contamination. Sites are reviewed on an annual basis for funding eligibility. Contracts are established annually with LHDs for collection of water samples and reporting results to well owners at specified sites of groundwater contamination.

2.11 Environmental Health

Working closely with LHDs, the MDEQ protects public health and the environment through administration of regulatory programs dealing with manufactured housing communities, campgrounds, and public swimming pools. The MDEQ also assures that suitable site conditions are present for proposed residential or commercial developments dependent on individual on-site sewage systems and wells, and regulates the proper collection and disposal of wastes by septic tank pump and haul operators.

2.12 Drinking Water and Wastewater Infrastructure Financial Assistance

The MDEQ, in conjunction with the Michigan Finance Authority, operates three revolving fund loan programs that can provide financial assistance to local units of government and public water suppliers for the construction of needed wastewater and drinking water infrastructure.

These programs provide loan assistance at interest rates well below open market, with the intention of supporting the department's compliance programs and reducing the costs to be passed on to the users of water and wastewater systems. Debt service payments are returned to the funds and hence "revolved" as they are lent out again. The three programs are:

- **Clean Water State Revolving Fund (CWSRF):** The CWSRF has been in operation in Michigan since 1989 and to date has tendered 499 loans totaling over \$4.1 billion. The CWSRF has played a critical role in the state's Combined Sewer Overflow (CSO) and Sanitary Sewer Overflow Control Programs, and will operate in perpetuity to provide assistance to wastewater system owners for ongoing capital improvement needs. In addition to financing Section 212 projects (Publicly Owned Treatment Works) the CWSRF can also fund Section 319 projects (nonpoint source [NPS] pollution control projects). The fund is capitalized by an annual federal grant and a required state match, with potential access to proceeds from the sale of Great Lakes Water Quality Bonds.
- **Drinking Water Revolving Fund:** The Drinking Water Revolving Fund has been in operation in Michigan since 1998 and to date has tendered 252 loans totaling over \$757 million. Patterned after the CWSRF, the Drinking Water Revolving Fund continues to play a critical role in furthering the MDEQ's public water system program and ensuring the protection of the health of Michigan citizens who are served by public water supplies.
- **Strategic Water Quality Initiatives Fund (SWQIF):** The SWQIF program was created in 2002 and is capitalized solely by proceeds from the sale of Great Lakes Water Quality Bonds. The SWQIF can fund two specific kinds of projects that are not eligible under the CWSRF because the facilities constructed would not be in public ownership: (1) The on-site upgrade or replacement of failing septic tanks/tile fields; and (2) The removal of storm water or groundwater from sanitary or combined sewer leads. Through fiscal year 2013 the SWQIF has tendered 21 loans totaling over \$24 million.

2.13 Great Lakes

The Great Lakes form a portion of the international boundary between the United States and Canada, and both countries have jurisdiction over their use. The first Great Lakes Water Quality Agreement between the two federal governments was developed in 1972 and established objectives and criteria for the restoration and enhancement of water quality in the Great Lakes system. A revised Great Lakes Water Quality Agreement was signed in 1978 recognizing the need to understand and effectively reduce toxic substance loads to the Great Lakes. The 1978 Great Lakes Water Quality Agreement adopted general and specific objectives and outlined programs and practices necessary to reduce pollutant discharges to the Great Lakes system. Under the 1987 Protocol that amended the 1978 Great Lakes Water Quality Agreement, the United States and Canadian governments identified 43 of the most polluted areas in the Great Lakes basin that had serious water quality problems known to cause Beneficial Use Impairments of the shared aquatic resources. These areas have been formally designated by the two governments as Areas of Concern (AOCs). Five AOCs were subsequently restored and delisted.

Ten AOCs are exclusively under Michigan jurisdiction: Clinton River, Deer Lake, Kalamazoo River, Manistique River, Muskegon Lake, River Raisin, River Rouge, Saginaw River/Bay, Torch Lake, and White Lake (Figure 2.1). The Menominee River AOC is shared with Wisconsin, and the Detroit River, St. Clair River, and St. Marys River are binational AOCs. The latter AOCs are managed jointly by a binational governance structure created under the Four Agency Letter of Commitment (also called the Four Agency Agreement) that was signed on April 17, 1998, by the Environment Canada, USEPA, MDEQ, and Ontario Ministry of the Environment.

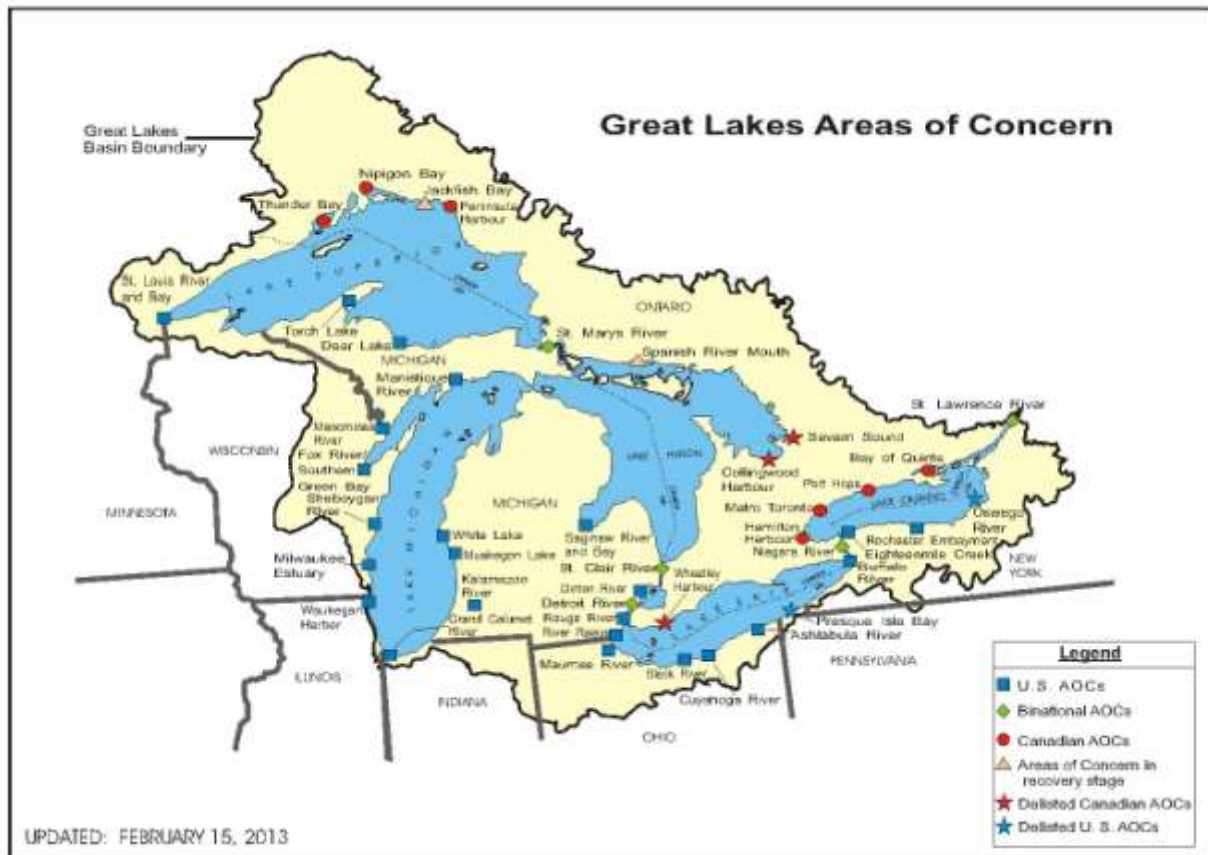


Figure 2.1. Great Lakes AOC (USEPA, 2013).

The 1987 Protocol called for cleanup of the AOCs through the development of Remedial Action Plans. The Great Lakes Water Quality Agreement was revised again in 2012, but the latest revision did not significantly change the requirements for Remedial Action Plans. Each Remedial Action Plan is required to identify problems that have led to Beneficial Use Impairments, identify actions needed to restore the beneficial uses, and provide documentation when beneficial uses are restored. Both federal governments play an active role in the implementation of the Remedial Action Plans. All of Michigan's 14 AOCs have completed Remedial Action Plans that are currently at various stages of implementation. Information regarding Michigan's AOCs and Remedial Action Plans is available at <http://www.michigan.gov/deqwater> in the AOC section under the Great Lakes, or from the Michigan Statewide Public Advisory Council at <http://www.glc.org/spac/>. A copy of the state's Guidance for Delisting Michigan's Great Lakes AOCs can be found at <http://www.michigan.gov/deqwater> in the AOC section under Great Lakes.

The 1987 and 2012 Protocols required the development and implementation of Lakewide Action Management Plans (LAMPs) for each of the Great Lakes. The purpose of the LAMPs is to address critical pollutants and provide a strategy to protect and restore beneficial uses impacted in the open waters of each Great Lake. The USEPA, in cooperation with other government and nongovernment agencies, has developed LAMPs for Lakes Erie, Michigan, and Superior. Each LAMP includes an assessment of Beneficial Use Impairments, causes of the impairment, and recommendations on actions necessary to restore the beneficial uses. In undertaking the development of the LAMPs, the stakeholders recognized the need to address other water quality issues unique to each Great Lakes basin. The LAMPs have been updated regularly, with summary reports issued every year.

A formal LAMP has not yet been developed for Lake Huron. Instead, the MDEQ, USEPA, Environment Canada, Ontario Ministry of the Environment, and Ontario Ministry of Natural Resources have formed the core of a Lake Huron Binational Partnership to coordinate environmental activities in the Lake Huron basin. The group developed a Lake Huron Binational Partnership Action Plan, which is expected to be converted into a LAMP.

2.14 Groundwater Discharge

The MDEQ's Groundwater Discharge Program regulates discharges to the ground through the development and issuance of permits and self-certifications. A "program review team" was established to develop and implement recommendations as needed for the Groundwater Discharge Program. Some specific program accomplishments include the conversion of the groundwater permit database into the NPDES Management System to increase permitting effectiveness, section procedure updates to consolidate and streamline groundwater permitting procedures, and review of the groundwater permit application to improve permit applications and decrease processing time.

2.15 Industrial Pretreatment

The MDEQ implements federal and state rules designed to limit pollution from industrial discharges to municipal wastewater treatment facilities. In 1983, the USEPA approved Michigan's pretreatment program and formally authorized the state of Michigan to oversee the program. To assure that pollutant discharges are controlled, many municipalities have been required to develop and implement local industrial pretreatment programs as a condition of their NPDES permit. Michigan operates under a two-tiered system: municipalities subject to industrial pretreatment program regulation with design flows greater than five million gallons per day must develop a federal local industrial pretreatment program, while municipalities subject to industrial pretreatment program regulation with design flows less than or equal to five million gallons per day must develop a Michigan local industrial pretreatment program.

Municipalities developing industrial pretreatment programs are required to submit them to the MDEQ, WRD, for review and approval. Subsequent changes to an approved local industrial pretreatment program, as well as periodic reports of local program operations, must also be submitted for review. MDEQ field staff conducts periodic inspections of local industrial pretreatment programs to identify deficiencies and initiate actions necessary to assure effective operation. Information derived from inspections and reports submitted by the municipalities are entered into the NPDES Management System database.

2.16 Infrastructure Security

Due to terrorist attacks on September 11, 2001, and recent federal legislation and state authorizations, the MDEQ actively participates in numerous critical Infrastructure Security Program activities implementing the Water Sector Security Program. The federal Public Health Security and Bioterrorism Preparedness and Response Act of 2002 requires drinking water systems to comply with requirements by certain dates as a part of the nation's homeland security efforts. The MDEQ plays a critical role in training and assisting the drinking water and wastewater system personnel to comply with the federal Water Sector Critical Infrastructure Security Program. The MDEQ helps to protect public water and wastewater systems from malevolent acts by providing training to complete vulnerability assessments and emergency response plans, participating in Water Sector security tabletop exercises, and assisting local units of governments including maintaining the Threat Advisory Notification System (TANS).

2.17 Inland Lakes and Streams

The Inland Lakes and Streams Program is responsible for the protection of the natural resources and the public trust waters of the inland lakes and streams of the state. The program oversees and regulates activities including dredging, filling, constructing or placement of a structure on bottomlands, constructing a marina, interfering with natural flow of water, or connecting a natural or artificially created waterway to an inland lake or stream.

The most common projects associated with inland lakes and streams regulated under Part 301, Inland Lakes and Streams, of the NREPA, include shore protection, permanent docks or boat hoists, beach sanding, and dredging or excavation. Other types of activities may also require permits.

2.18 National Pollutant Discharge Elimination System

Discharges to state surface waters from municipal, industrial, and commercial facilities must be authorized by permit under the NPDES Program. All Concentrated Animal Feeding Operations in Michigan are also required to obtain an NPDES permit, except for those that are granted a "No Potential to Discharge" determination by the MDEQ. The purpose of an NPDES permit is to control the discharge of pollutants into surface waters of the state to protect the environment. The USEPA delegated the program to Michigan, and the MDEQ has responsibility for processing NPDES permits. The maximum term for an NPDES permit is five years, after which they must be reissued.

The MDEQ reissues NPDES permits according to the five-year rotating watershed cycle, two years after the monitoring year (Figure 3.1). Under this approach, all of the permits in each individual watershed expire and are reissued in the same year. This approach allows the MDEQ to consider cumulative impacts of all dischargers on water quality in the watershed. Discharges to lakes, streams, and wetlands must not cause a violation of Michigan WQS. As part of the permit issuance process, limits are developed for pollutants to avoid a violation of WQS and ensure compliance with the treatment technology regulations of the CWA. Draft permits are prepared containing pollutant limits and any appropriate special conditions. The draft permits are placed on public notice, allowing the opportunity for public comment.

The MDEQ was instrumental in amending the NREPA in 2004 to establish NPDES permit fees to assist in funding the NPDES Program.

Permits for regulated storm water discharges are also processed and issued by the MDEQ under the NPDES program. The Storm Water Program is also funded by fees collected from the dischargers. Under Phase I of the Storm Water Program, individual NPDES permits were issued to owners or operators of Municipal Separate Storm Sewer Systems (MS4s) serving a population of 100,000 or greater. In 2003, the MDEQ promulgated rules to obtain the legal authority to implement Phase II requirements. As a result, owners or operators of MS4s serving populations less than 100,000 within urbanized areas were required to apply for NPDES permits by March 2003. Phase II permittees include cities, villages, townships, county road commissions, and county drain commissions, among others. A jurisdictional-based general permit, as well as the watershed-based general storm water permit, is used to provide permit coverage.

Michigan uses a general permit for industrial storm water discharges. The general permit requires the permittee to have a certified storm water operator and prepare and implement a Storm Water Pollution Prevention Plan. The applicability of this permit includes storm water discharges associated with industrial activity as defined in the federal regulations, and from special use areas (state- or federally-mandated secondary containment structures, areas

designated on Michigan's List of Sites of Environmental Contamination pursuant to Part 201, Environmental Remediation, of the NREPA, and other activities subject to federal storm water regulation where storm water monitoring is necessary on a case-by-case basis). Monitoring is required only from the special use areas. Industrial storm water general permits and Certificates of Coverage are reissued on a watershed-basis with approximately one-fifth of the five-year permits reissued each year.

The MDEQ has continued implementation of the state's CSO Control Program, which has resulted in annual reductions of the volume of untreated combined sewage discharged to the surface waters of the state. Through implementation of the CSO Control Program, numerous CSO discharges are being eliminated at various locations around the state, while at other locations, treatment and disinfection of combined sewage discharges that comply with WQS and protect public health are being provided on an increasing basis.

2.19 Nonpoint Source Control

The NPS Program assists local units of government, nonprofit entities, and other state, federal, and local partners to restore impaired waters, protect high quality waters, and reduce NPS pollution statewide. The basis for the program is watershed management; the MDEQ provides assistance and funding to develop Watershed Management Plans (WMP) and to implement NPS control activities in these plans. The NPS Program conducts or supports the following activities to accomplish the Program's restoration and protection goals:

- Technical assistance to help organizations develop and implement WMPs, including Best Management Practice selection, land use planning activities, and engineering review of site plans.
- Information and education, including activities/tools created by the MDEQ and grantees, to educate people about NPS of pollution.
- Grants to implement WMPs.
- Compliance and enforcement, including response and investigation of complaints, follow-up requiring corrective actions, and occasionally participating in escalated enforcement actions.
- Monitoring and field investigations to identify NPS problems and evaluate the effectiveness of corrective or preventive actions.

Approximately 140 WMPs have been developed at the local level and most of these were developed by local watershed groups utilizing MDEQ grants. WMPs serve as guides for communities to protect and improve water quality. A list of MDEQ-approved WMPs that meet CMI and/or Section 319 criteria for implementation is available at <http://www.michigan.gov/deqnps>.

The NPS Program has identified a number of priority watersheds in which to focus pollution control activities to achieve the restoration and protection goals identified in Michigan's NPS Program Plan. The priority watersheds are identified in Appendix 4 of Michigan's NPS Program Plan.

2.20 Septage

Septage is a domestic waste pumped from septic tanks, portable toilets, etc. The Septage Program regulates the septage hauling industry and septage disposal practices. Companies, as well as the vehicles they use, must be licensed. In addition, a permit is required to apply septage to the land. Septage may be taken to a municipal wastewater treatment facility or may be applied to agricultural land. The MDEQ administers the program with assistance from participating LHDs.

2.21 Soil Erosion and Sedimentation Control

The Soil Erosion and Sedimentation Control Program is administered under the authority of Part 91, Soil Erosion and Sedimentation Control, of the NREPA. Part 91 provides for the control of erosion and prevention of off-site sedimentation from earth change activities. Part 91 is administered and enforced by state, county, and municipal agencies with oversight by the MDEQ.

The MDEQ's major responsibilities are to train staff members of the Part 91 agencies in the proper administration and enforcement of Part 91 and to conduct periodic audits of the administering agencies to ensure their Soil Erosion and Sedimentation Control Programs are in compliance with Part 91.

2.22 Wetlands Protection

The MDEQ, WRD, has administered a statewide wetland regulatory program for over 30 years. The WRD also manages Michigan's wetland resources through public education programs that encourage wetland preservation and restoration, cooperation with governmental and nongovernmental agencies to encourage the evaluation and management of wetlands on a local and watershed basis, and development of a monitoring and assessment program.

Michigan's Goemaere-Anderson Wetland Protection Act was passed in 1979 (Part 303 of the NREPA). Through passage of the Wetland Protection Act, Michigan took direct legislative action to regulate and minimize wetland losses. This act provides for the preservation, management, protection, and use of wetlands; requires permits to alter wetlands; and provides penalties for illegal wetland alteration. A wetland is defined in Part 303 as:

“ . . . land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life and is commonly referred to as a bog, swamp, or marsh.”

The Wetland Protection Act further defines regulated wetlands as those wetlands contiguous to the Great Lakes or Lake St. Clair, an inland lake, pond, river, or stream; and noncontiguous wetlands greater than five acres in size. The state also has the authority to regulate any noncontiguous wetlands that are determined to be essential to the preservation of the natural resources of the state once the landowner has been notified. Part 303 requires that persons planning to conduct certain activities in regulated wetlands apply for, and receive, a permit from the state before beginning the activity.

Michigan's regulatory program generally requires mitigation for all wetland impacts, although the MDEQ staff may waive this requirement for projects impacting less than one-third acre if no reasonable opportunity for mitigation exists, or for projects having a basic purpose of creating or restoring wetlands. Mitigation may be considered only after the applicant has demonstrated avoidance and minimization of impacts, and it has been determined that a project is otherwise permissible. A mitigation proposal must result in no net loss of wetlands upon completion of a project. Mitigation requirements and ratios are established by rule and are defined by staff as a condition of the permit decision. Financial assurances are required to ensure completion of any mitigation project that is not completed in advance of associated impacts. Mitigation sites must be permanently protected through a conservation easement. Administrative rules defining the establishment and use of mitigation banks were promulgated in 1997 (see R 281.951, Wetland Mitigation Banking). Fifteen mitigation banks are currently listed in Michigan's Wetland Mitigation Bank Registry. A number of other mitigation bank sites are currently under consideration or development.

Michigan also has developed other regulatory and nonregulatory programs to manage Michigan's wetland resources, including:

- Part 303 authorizes regulation of wetlands by a local unit of government provided that the local unit uses the same definition of wetlands as Part 303, and permit criteria that are consistent with Part 303. Currently, over 40 communities in Michigan have local wetland protection ordinances.
- The MDEQ has organized and leads the Wetland Work Group, an informal interagency team including various state, federal, and nongovernmental organizations concerned with wetland restoration and management.
- To encourage consideration of wetland issues, the WRD provides technical assistance to local watershed planning organizations. WRD staff have been working closely with watershed groups to assist in locating areas that have a high potential for wetland restoration. Using existing datasets and GIS technology, WRD staff created a GIS layer that highlights these wetland restoration areas and ranks them in terms of their potential (high, moderate, and low).
- The WRD has developed a landscape-scale wetland assessment method to assist watershed groups in managing, protecting, and restoring wetlands in the context of watershed management planning. Originally developed by the USFWS, the WRD makes use of GIS data, including National Wetland Inventory maps, to provide an evaluation of wetland functions to make more effective decisions regarding the need for wetland protection, restoration, or management in watershed. All counties were completed and certified in January 1, 2007, and are available on the MDEQ online GIS tool - Wetlands Map Viewer (<http://www.mcgi.state.mi.us/wetlands/>)
- The MDEQ provides for protection of wetlands through the use of conservation easements that offer comprehensive and permanent protection to high quality wetlands. Conservation easements over exceptional wetland sites may be provided to fulfill mitigation requirements, when appropriate, or wetlands that are avoided during the planning of an authorized construction project may also be protected under an easement.

The WRD is working with partners to develop a wetland monitoring and assessment program to assess the quality and quantity of Michigan's wetland resources and guide future program development. This includes recent development of the Michigan Rapid Assessment Method (MiRAM) and Landscape Level Wetland Assessment, as well as working with Great Lakes researchers on coastal wetland monitoring, developing Indices of Biological Integrity (IBI's), and the National Wetland Condition Assessment (NWCA).

The MiRAM was finalized in 2010, and is used by regulatory staff as appropriate to propose preservation mitigation sites, compliance sites, etc. Future plans exist to implement a MiRAM monitoring program, on a five-year cycle. The *Great Lakes Coastal Wetland Monitoring Plan* (*Great Lakes Coastal Wetland Consortium, 2008; <http://www.glc.org/wetlands/final-report.html>*) was developed addressing Fish, Invertebrates, Amphibians, Birds, Vegetation, and Chemistry indicators. Additionally, future plans include implementation an intensification of the NWCA, to continue partnership with Great Lakes Coastal Wetland monitoring group, and to incorporate aquatic invasive species and climate change monitoring protocols when they become available

2.23 Clean Water Act Section 404 Permit Program

Michigan's Wetland Protection Program was approved by the USEPA in accordance with the requirements of Section 404(h) of the CWA in August 1984. With this approval, Michigan became the first state to assume administration of Section 404. Although at least 34 states have their own wetlands program, only 2 states, Michigan and New Jersey, have been able to

meet all the requirements to assume the CWA Section 404 Program. The CWA limits state assumption of Section 404 authority in “traditionally navigable waters.” The United States Army Corps of Engineers, Detroit District, retains Section 404 jurisdiction in these waters, which includes the Great Lakes, connecting channels (such as the Detroit River), and river mouth areas upstream to the limits of the traditional navigational channel or the Great Lakes ordinary high water mark.

To maintain Michigan’s authorization under Section 404, state law must remain consistent with federal regulation including exemptions, general permits, public notice procedures, and review criteria. In addition to meeting these requirements, Michigan’s law provides the citizens of the state with a significant savings in time and money while providing efficient and effective protection of wetland, lake, and stream resources by clearly defining wetlands that are regulated, providing permitting time frame requirements, and streamlining and consolidating permit review.

The MDEQ processes approximately 4,000 to 6,000 permit applications per year under Section 404. About 1,500 of these applications propose wetland impacts; the remainder propose to alter lakes and streams only. The MDEQ staff work with permit applicants to redesign proposals, when necessary, to avoid and minimize resource impacts. The MDEQ is currently working, under an EPA Water Permits Division Grant, to develop a comprehensive database for Michigan’s Section 404 Program that will incorporate new technologies and methods for screening, evaluating, and tracking impacts.

In 2008, the USEPA published findings from a 10-year review of Michigan’s Section 404 Program and although the USEPA found that, in general, Michigan’s administration of the program was good, they identified changes that are needed to maintain federal consistency. These changes include administrative actions/procedures, revision of administrative rules, statute amendments to clarify exemptions, and updating the program Memorandum of Agreement. After working with stakeholders on the changes required to maintain our state program, Michigan’s legislature passed a new law in 2013 that includes many of the necessary changes for Michigan’s 404 program as well as several other programmatic changes. The USEPA is currently evaluating these changes to determine whether they are consistent with the Clean Water Act.

2.24 Water Protection Special Initiatives

2.24.1 Aquatic Invasive Species

Michigan’s aquatic ecosystems are experiencing significant negative effects from AIS that are already present and the state’s waters are continually threatened by new invasions. An invasive species is defined as a species that is not native and whose introduction causes, or is likely to cause, economic or environmental harm, or harm to human health.

The introduction of AIS into the Great Lakes and inland state waters is a source of biological pollution that has significant negative effects throughout the state and region. AIS may compete with native species for food and habitat, and can directly or indirectly harm or displace native species, degrade habitat, and alter food webs and energy flow. AIS can also have significant economic effects on waterfront property values, tourism, utilities, and other industries (Lovell et al., 2005).

The Great Lakes region has been impacted by both the intentional and unintentional introduction of AIS since the settlement of the region by Europeans. Since the 1800s, at least 182 nonindigenous aquatic organisms have colonized habitats of the Great Lakes ecosystem. These species include: algae (27), vascular plants (55), invertebrates (66), fish (28), and

bacteria and viruses (6) (NOAA, 2011). About 55 percent of these species are native to Eurasia; 13 percent are native to the Atlantic Coast. Prior to the institution of new ballast water management regulations in July 2006, a new nonindigenous species was being discovered in the Great Lakes, on average, once every 28 weeks (Ricciardi, 2006; Great Lakes Environmental Research Laboratory, 2009).

AIS enter and disperse in Michigan waters through various human-assisted vectors including: maritime commerce (e.g., oceangoing ship ballast water and hull fouling), fishing and aquaculture, canals and diversions, the trade of live organisms, and tourism and development activities (Lodge and Finnoff, 2008; Pimentel et al., 2000). Actions taken to date to prevent the introduction of new AIS include regulatory and voluntary efforts by both public and private entities. A wide variety of educational programs have increased awareness of the introduction pathways to prevent new AIS, such as those aimed at recreational boating and invasive organisms in trade (both at the industry level and the consumer level). Government agencies and nongovernmental partners monitor for existing and new AIS and provide assessments of AIS management efforts. However, much work remains to protect Michigan waters from new introductions of AIS from around the world, other waters across the country, and adjacent areas of the Great Lakes watershed as well as minimize the harmful effects of AIS already in Michigan waters.

A variety of federal and state legislation addresses AIS. In particular, the federal Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (amended by the National Invasive Species Act of 1996) addresses the issue of invading species. This law has five purposes:

- Prevent unintentional introductions.
- Coordinate research, control, and information dissemination activities.
- Develop and carry out environmentally sound control methods.
- Minimize economic and ecological impacts.
- Establish a research and technology program to benefit state governments.

Part 413, Transgenic and Nonnative Organisms, of the NREPA, was last amended in 2009 and provides a list of prohibited and restricted invasive species within the state. In addition to creating a list of both restricted and prohibited species, the act defines possession regulations, lays out a permitting process, and lists violations, penalties, and liabilities. The MDNR and MDARD are responsible for administering Part 413.

An AIS Advisory Council was established in December 2011 pursuant to Part 414, AIS Advisory Council, of the NREPA. Through this legislation, the Governor and Legislature directed the AIS Advisory Council to provide recommendations on:

- Michigan's AIS State Management Plan.
- Ballast water regulations.
- Organisms in trade.
- Control and management of Phragmites.
- Financial and other resources needed to implement Michigan's AIS state management plan and AIS Advisory Council recommendations.

The AIS Advisory Council's final recommendations were submitted to Governor Rick Snyder and the Legislature in August 2013.

Michigan's first Aquatic Nuisance Species State Management Plan was approved in 1996, updated in 2002, and most recently updated in 2013. This plan, now called the AIS State Management Plan, was approved by the Aquatic Nuisance Species Task Force in June 2013. The updated comprehensive AIS State Management Plan outlines new actions in addition to

maintaining and enhancing existing efforts to adequately prevent and control AIS in Michigan waters, including the Great Lakes, connecting channels, rivers, streams, inland lakes, and wetlands.

The AIS State Management Plan identifies strategic actions in categories including legislative and policy, regulation (including compliance, enforcement, and inspection), information and education, research and monitoring, and early detection and response. The prevention of nonnative, aquatic organisms including microorganisms (pathogens), invertebrates, algae, aquatic vascular plants, fish, other animals, and parasites that enter and establish populations in Michigan waters and cause harm to the environment, economy, or human health are considered using a vector and pathway approach. The AIS State Management Plan also integrates and builds upon existing AIS prevention and control efforts.

The AIS State Management Plan addresses four goals:

- Goal I: Prevent new introductions of AIS into Michigan waters.
- Goal II: Limit the dispersal of established populations of AIS.
- Goal III: Develop a statewide interagency early detection and response program to address new invasions.
- Goal IV: Manage and control AIS to minimize the harmful effects.

Michigan recognizes the potential threats of new AIS to the Great Lakes; therefore, measures are being taken to prevent introductions via three specific high priority pathways: ballast water discharges, Chicago Area Waterway System, and Organisms in Trade.

Ballast water discharges from ocean-going vessels (water taken onboard large vessels to provide stability and balance during a voyage) is a significant contributor to the introduction of AIS; therefore, Michigan passed ballast water control legislation in 2005. Pursuant to this legislation, the MDEQ implemented a state ballast water discharge permit program for oceangoing vessels. Michigan reissued its ballast water general permit in February 2012. The USEPA issued a federal Vessel General Permit in 2008 as a result of a 2005 United States court ruling. However, in April 2009, the MDEQ filed a petition challenging the USEPA Vessel General Permit in the 6th Circuit Court. Michigan's challenge along with those filed by several environmental organizations in three other United States Circuit Courts was consolidated by Order in the United States Circuit Court of Appeals for the Washington DC Circuit Court in May 2009. The petition claims that the USEPA failed to immediately and comprehensively regulate the discharge of ballast water from oceangoing vessels in the Great Lakes in a manner that satisfies WQS through the Great Lakes ecosystem and adequately protects those waters against further introductions of harmful invasive species when it issued the Vessel General Permit. Michigan reached a settlement agreement with the USEPA in February 2011 and the steps outlined in the settlement agreement were implemented. The USEPA reissued the second iteration of the Vessel General Permit in March 2013. In addition, the United States Coast Guard issued final regulations pertaining to ballast water discharges in March 2012. Despite these actions at the federal level, Michigan's ballast water legislation and state permit remain effective in order to prevent further AIS introductions.

Michigan continues to promote actions to prevent Asian carps (i.e., silver and bighead carp) from invading the Great Lakes through a variety of activities. By participating in the Asian Carp Regional Coordinating Committee, Michigan is working to ensure continued operation of existing short-term preventative measures at the Chicago Area Waterway System. Beginning in 2009, Michigan was involved in litigation filing suit in the United States Supreme Court against the state of Illinois and the Metropolitan Water Reclamation District of Greater Chicago for allowing Asian carp to potentially invade the Great Lakes through the Chicago Sanitary and Ship Canal and other managed waterways. The suit called for the development and

implementation of plans to permanently and physically separate carp-infested waters in the Illinois River basin, the canal, and connected waterways from Lake Michigan as well as the implementation of immediate actions to close some of the locks on the Chicago Sanitary and Ship Canal and connecting channels, operate electric barriers in the canal at maximum efficiency, and monitor for Asian carp and eradicate any Asian carp found. The states of Ohio, Minnesota, Wisconsin, New York, and Pennsylvania, and the Canadian Province of Ontario joined Michigan in support of these efforts. Ultimately, in September 2011, a federal Court of Appeals panel upheld a District Court ruling denying the request for immediate action; however, Michigan remains vigilant in actions to prevent Asian silver and bighead carp. For example, Michigan is participating in meetings with the Great Lakes Commission to develop funding options for addressing hydrologic separation in the Chicago Area Waterway System.

Michigan continues to support federal legislation addressing Asian carp including the proposed "Close All Routes and Prevent Asian Carp Today" (or CARP ACT). The legislation would direct the United States Army Corps of Engineers to implement many of the same emergency measures to keep Asian carp out of the Great Lakes. Discussions and activities to prevent Asian carp from becoming established in the Great Lakes are ongoing.

Prevention of AIS via pathways associated with Organisms in Trade is another high priority pathway. Aquatic plants and animals that have been introduced through channels of trade pose a significant threat to Michigan waters. For the most part, these organisms have been obtained deliberately, such as plants and animals popular for the aquarium, ornamental pond trade, or as culinary products. Channels of trade include traditional sales to and through retail stores or markets, as well as increasing sales through the global internet marketplace.

AIS obtained through trade find their way into lakes and streams through a variety of pathways. Although well intentioned, uneducated consumers may purposefully release unwanted pets or plant species and associated pathogens, believing it is a humane action without knowing the damaging consequences to the environment. The live food fish industry also poses a risk of introducing AIS into Michigan waters through the improper disposal of shipping material containing AIS and through consumers that may release live fish purchased at food markets directly into water bodies for cultural or spiritual reasons. AIS can also be distributed unintentionally and unknowingly through sales of aquatic species as contaminant species associated with legitimately sold species, or through misidentification and unfamiliarity with a given species' common or scientific name. Increased inspections of live food markets; bait retailers and wholesalers; and retailers that have the potential to sell aquatic plants for use in water gardens and backyard pond settings such as pet shops, aquarium stores, nursery stock growers, and plant dealers have increased beginning in 2011 along with the distribution of educational information on prohibited and restricted species.

Michigan's AIS State Management Plan, additional information on these priority pathways, and the AIS program in general is available at www.michigan.gov/aquaticinvasives.

2.24.2 Saginaw Bay Coastal Initiative

The Saginaw Bay Coastal Initiative was formed in August 2006. Through the Saginaw Bay Coastal Initiative, the MDEQ and other state agencies started working with citizens, local government officials, and multiple regional and federal agencies to develop and implement a comprehensive approach to promoting environmentally sound economic development and resource restoration in the Saginaw Bay coastal areas. The MDEQ continues to be engaged in the process, but the leadership of this effort has shifted to the local stakeholders and the increased ownership this brings better enables the continued work toward the goals of:

- Identifying methods to enhance the economic development of the Saginaw Bay coastal area and the quality of its parks and beaches and other natural areas.
- Seeking partnerships to develop new cultural, recreational, and social resources for Saginaw Bay area citizens and visitors.
- Working with local interests to improve water quality in Saginaw Bay and its associated waterways.

The Saginaw Bay Coastal Initiative encourages regular discussions to determine how state, federal, and local interests can work together to achieve resource protection, improve environmental quality, and expand economic development. This includes opportunities to discuss the local impact of state and federal programs and to look for opportunities to meet the goals of these programs through new and innovative means. Additional information regarding the Saginaw Bay Coastal Initiative can be found at <http://www.michigan.gov/deq/> under Issues to Watch.

Shoreline deposits of decaying organic matter, abundant plant and algae growth, and beach closures are a concern along Saginaw Bay and other Great Lakes nearshore areas (see Chapter 5). In 2008, the NOAA initiated an extensive, five-year study of Saginaw Bay to generate a better understanding of the multiple stressors that are affecting the character of both the nearshore and open water regions of Saginaw Bay. This study was devoted to understanding the mechanisms and processes that are affecting the bay. The NOAA multi-stressors final report can be viewed at http://docs.lib.noaa.gov/noaa_documents/OAR/GLERL/TM/GLERL_160.pdf. The MDEQ is collaborating with researchers in an effort to address questions about designated use support.

2.25 Cost/Benefit Assessment

The activities described in this chapter are carried out by several MDEQ divisions and offices. Full quantification of expenditures is not possible at this time. However, the WRD alone spent approximately \$50.9 million in Fiscal Year 2012 and \$57.1 million in Fiscal Year 2013 for the implementation of water quality protection, restoration, and monitoring programs. Sources include federal funds, state general funds, CMI state bond funds, and fees. These expenditures support MDEQ staffing and operating expenses as well as grants and loans to local governments and organizations. A variety of water quality protection activities are implemented through these funds, including regulatory requirements, technical and financial assistance, and education/outreach efforts. These expenditures also leverage substantial local funds and services, since many of the programs and grants have cost-share or match requirements.

The benefits associated with the implementation of these programs are numerous, although it is not possible to accurately quantify the benefits in strictly monetary terms. From a financial perspective, citizens and out-of-state tourists are estimated to spend over \$10 billion each year on Michigan tourism, much of that on outdoor sports and recreation that depend on clean water, air, and forests. Popular activities include hunting, fishing, boating, and swimming at Great Lakes and inland beaches. The revenues from these activities far exceed the money spent on water quality protection and monitoring activities each year. Aside from strictly financial considerations, clean water is also essential to protect human health, drinking water quality, biological diversity, and quality of life issues, which attract many businesses and citizens to live and work in Michigan.

CHAPTER 3 WATER QUALITY MONITORING

Environmental monitoring is an essential component of the MDEQ mission. Comprehensive water quality monitoring is necessary to improve natural resource management, maintain sustainable ecosystems, and protect public health. Although the MDEQ is the lead state agency responsible for monitoring, assessing, and managing the state's surface water and groundwater, effective water



resource management is best achieved through the formation and implementation of meaningful coalition partnerships with outside entities including other state and federal agencies, Canadian organizations, local governments, tribes, universities, industry, environmental groups, and citizen volunteers. Wherever possible, the MDEQ strives to organize and direct the resources and energies created by these partnerships through a “watershed approach” to protect the quality and quantity of the state's water resources.

Many MDEQ water quality monitoring and water pollution control programs are integrated and implemented according to a 5-year rotating watershed cycle to facilitate effective watershed management. Michigan has 57 major watersheds based on the USGS's 8-digit HUCs. Water quality assessment efforts focus on a subset (approximately 20 percent) of these major watersheds each year (Figure 3.1).

In January 1997, the MDEQ completed a monitoring report entitled, “A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters” (Strategy) (MDEQ, 1997). It was developed specifically to identify the activities and resources needed to establish a comprehensive, state-of-the-art water quality monitoring program, and has guided Michigan's monitoring program implementation. The Strategy consists of nine interrelated elements: fish contaminants, water chemistry, sediment chemistry, biological integrity, wildlife contaminants, bathing beaches, inland lake quality and eutrophication, stream flow, and volunteer monitoring. The Strategy specifically identifies four monitoring goals:

- Assess the current status and condition of waters of the state and determine whether WQS are being met.
- Measure spatial and temporal water quality trends.
- Evaluate the effectiveness of water quality protection programs.
- Identify new and emerging water quality issues.

The evolving nature of management and program needs, technology, and technical monitoring guidance/science requires continuous evaluation of existing activities to ensure effective, comprehensive monitoring and to identify opportunities for improvement. Program assessment led to an update of the 1997 Strategy in May 2005 (MDEQ, 2005a) (available at <http://www.michigan.gov/deqwater> under Water Quality Monitoring, Assessment of Michigan Waters). Another impetus for the update was a requirement by the USEPA that states produce a comprehensive monitoring program strategy that serves all water quality management needs

and addresses all state waters. The purpose of the update was to: (1) describe ongoing monitoring activities (including monitoring objectives, study design, indicators, data analysis, data management, and reporting); (2) identify potential future monitoring activities, to the extent possible; (3) identify program gaps and a timeline for addressing them; and (4) specify resource needs (staff, funding, and technical).

In regards to wetland monitoring, the four goals of Michigan's Water Quality Monitoring Strategy are addressed in a separate document entitled the "State of Michigan Wetland Monitoring and Assessment Strategy," which was updated in 2013. This strategy follows the 3-Tiered Technical Approach – Level 1: Landscape Assessment, Level 2: Rapid Wetland Assessment, and Level 3: Intensive Site Assessment - outlined of the EPA publication *Application of Elements of a State Wetland Monitoring and Assessment Program* (USEPA, 2006). The objectives of the wetland monitoring and assessment strategy are:

- Objective 1:* Complete an inventory of Michigan's wetland resources that provides both fundamental resource information and a baseline for evaluating gains and losses over time.
- Objective 2:* In order to support state and national no net loss/net gain goals for wetlands, cooperate in updating of National Wetland Inventory maps for use in status and trends reporting.
- Objective 3:* Assess the effectiveness of Michigan's state-administered Section 404 permit program by tracking authorized impacts and mitigation for those impacts, as well as documented unauthorized impacts and restoration measures.
- Objective 4:* Apply Landscape Level Functional Wetland Assessment methods to support the protection, management, and restoration of wetlands on a watershed scale.
- Objective 5:* Evaluate individual wetland sites using the Michigan Rapid Assessment Method to quickly assess the wetland functions and values on an equal scale regardless of ecological type.
- Objective 6:* Use full scale biological assessment of wetlands for resource management purposes. Develop and document wetland Indices of Biological Integrity (IBI's) and related methods.
- Objective 7:* In cooperation with other public and private agencies and organizations, provide for the evaluation of Michigan's most outstanding wetland resources, especially Great Lakes coastal wetlands, by supporting the long-term monitoring of wetlands through the Great Lakes Coastal Wetland Consortium and similar cooperative efforts.
- Objective 8:* Assess statewide wetland quality by establishing a routine wetland monitoring program that parallels other basin-wide water quality monitoring, including the National Wetland Condition Assessment.

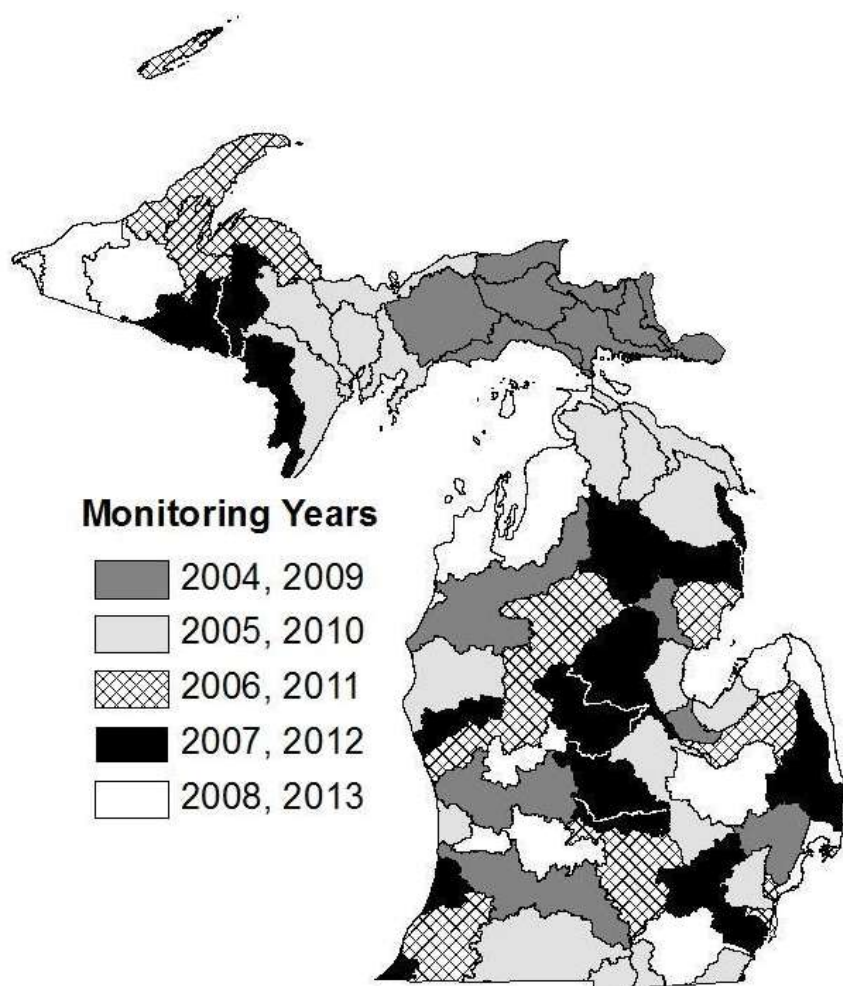


Figure 3.1 Five-Year Rotating Watershed Cycle.

CHAPTER 4 ASSESSMENT METHODOLOGY

4.1 Introduction

Michigan's assessment methodology describes the data and information used to determine designated use support, explains how these data and information are used to determine designated use support for surface waters of the state, and describes how surface water resources are reported using five categories (fully supporting, partially supporting, not supporting, insufficient information, or not assessed). Ultimately, this methodology describes the process used to develop several of the appendices and summary tables included in this IR to satisfy the requirements of Sections 305(b) and 303(d) of the federal CWA.

The internal coordination and review process used to generate Sections 305(b) and 303(d) lists is carried out by a team of MDEQ technical staff and managers with considerable knowledge of local watershed conditions/issues and expertise in aquatic biology, limnology, ecology, environmental engineering, chemistry, microbiology, and mammalian/aquatic toxicology.



4.2 Data and Information Used to Determine Designated Use Support

The MDEQ considers readily available, adequately georeferenced, and quality checked data and information collected and submitted by the MDEQ, its grantees and contractors, other agencies, and the public (including volunteer monitoring groups). Sources of data and information include:

- The MDEQ's water quality monitoring program that includes eight interrelated elements: fish contaminants, water chemistry, sediment chemistry, biological integrity and physical habitat, wildlife contaminants, bathing beach monitoring, inland lakes monitoring, and stream flow (see Chapter 3).

As part of the MDEQ's water quality monitoring program, sites for biological integrity and water chemistry monitoring are selected using both targeted and probabilistic study designs. The probabilistic monitoring approach is used to address statewide and regional questions about water quality. Targeted monitoring is used to fulfill specific monitoring requests, assess known or potential problem areas or areas where more information is needed, achieve assessment coverage of a watershed, and provide information to support and evaluate the effectiveness of MDEQ water protection programs (e.g., NPDES, NPS, and Site Remediation). All site-specific data are considered to determine designated use support. Generally, the other types of monitoring are conducted using targeted study designs.

- Michigan's 2012 IR (Goodwin et al., 2012), which serves as a baseline for the 2014 IR and is modified using new data and information.

- Fish Consumption Advisories established by the Michigan Department of Community Health (MDCH) as of May 2013.
- Dilution calculations, trend analyses, or predictive models for determining the physical, chemical, or biological integrity of surface water bodies.
- Reports of fish kills and chemical spills.
- Surface water quality monitoring data submitted by the general public or outside agencies. This information was solicited by the MDEQ in a notice on the MDEQ Web-based Calendar in the following publications: January 14, January 28, February 11, and February 25, 2013.. Information was also solicited from the Michigan Department of Transportation, MDARD, MDNR, United States Forest Service, USFWS, USGS, USEPA, Alliance for the Great Lakes, and the Michigan Tribal Chairmen via e-mail on January 14, 2013.
- Surface water, drinking water, and source water quality assessments conducted under Section 1453 of the federal Safe Drinking Water Act, enacted by Public Law 93-523, December 16, 1974, as amended, through August 6, 1996, being Title 42 of the United States Code (U.S.C.), Section 300j-13.
- Remedial investigation/feasibility studies to support Records of Decision under the Comprehensive Environmental Response, Compensation, and Liability Act, 1980 PL 96-510 or Part 201 of the NREPA.

To ensure adequate time for proper data analysis, the MDEQ applies a cutoff date for newly collected data considered for the IR (i.e., data that were not used for development of the 2012 IR). For the 2014 IR, the MDEQ considered all new readily available and quality-checked water quality data and information collected by the MDEQ and its grantees/contractors within the two-year period immediately following the cutoff date considered for the 2012 IR. In other words, data collected during the period from January 1, 2011, to December 31, 2012, were considered for the 2014 IR. Data collected prior to January 1, 2011, that were unable to be used for the 2012 IR or that were helpful to understand conditions over a longer period of time given limited datasets were considered for the 2014 IR using the current assessment methodology. Water Chemistry Monitoring Program (WCMP) data collected through 2011 were used for this IR. WCMP data collected in 2012 were not quality-checked in sufficient time to be broadly used for this IR. However, data collected in 2012 and after the December 31, 2012, cutoff date were considered for inclusion in the 2014 IR on a case-by-case basis as determined appropriate by the MDEQ. TMDL documents completed through 2013 were used to prepare this IR. Water quality data collected since January 1, 2011, and submitted to the MDEQ by March 1, 2013, by other parties (e.g., in response to the data solicitation described in the above bulleted list, from the Michigan Clean Water Corps volunteer monitoring database, etc.) were evaluated according to this assessment methodology and potentially used to help prepare the 2014 IR.

The quality assurance/quality control requirements for water, sediment, and fish tissue chemistry and biological data collected by the MDEQ are described in the MDEQ's Quality Management Plan (MDEQ, 2005b). To ensure acceptable data quality, the MDEQ also requires all grantees or vendors receiving state or federal money for the purpose of conducting water quality monitoring to prepare and follow Quality Assurance Project Plans prior to sample collection (MDEQ, 2002a). Other data, such as data submitted by outside agencies or the public, must satisfy the MDEQ's quality assurance/quality control requirements to be used to make designated use support determinations of supporting or not supporting, to change the designated use support, or to reassign water bodies to different categories. Data that do not fully satisfy the MDEQ's quality assurance/quality control requirements or data that are collected

and analyzed using techniques that are less rigorous than techniques used by the MDEQ to make designated use support determinations may be used to list a water body for further evaluation (i.e., as insufficient information).

Each dataset for a water body is evaluated to determine if the data are representative of existing conditions and of adequate quality to make designated use support decisions. Data may not be representative of existing conditions if land use, point sources, or hydrologic conditions were substantially changed since the point of last data collection. Data may not be of adequate quality if field or laboratory methods changed to address quality concerns subsequent to data collection. In addition, the quantity of data; duration, frequency, magnitude, and timing of WQS exceedances; analytical method sensitivity; and contextual information (e.g., naturally occurring, weather, and flow conditions, etc.) are considered to ensure the data are representative of critical conditions. Target sample sizes may be given in this assessment methodology to determine designated use support; however, these sample sizes are not applied as absolute rules. Generally, data that are collected to determine compliance with permitted activities, such as NPDES discharge data, are not used to determine designated use support; however, ambient data that are collected for this purpose may be considered.

Water body, assessment, or data types that are not specifically discussed in this assessment methodology (including uncommon data or unusual circumstances) are considered on a case-by-case basis and are evaluated consistent with WQS.

4.3 Determination of Designated Use Support

At a minimum, all surface waters of the state are designated and protected for all of the following designated uses: agriculture, navigation, industrial water supply, warmwater fishery, other indigenous aquatic life and wildlife, partial body contact recreation, and fish consumption (R 323.1100[1][a]-[g] of the Part 4 rules). In addition, all surface waters of the state are designated and protected for total body contact recreation from May 1 to October 1 (R 323.1100[2]). Specific rivers and inland lakes as well as all Great Lakes and specific Great Lakes connecting waters are designated and protected for coldwater fisheries (R 323.1100[4]-[7]). Several specific segments or areas of inland waters, Great Lakes, Great Lakes bays, and connecting channels are designated and protected as public water supply sources (R 323.1100[8]). The Part 4 rules form the basis for this assessment methodology.

Most designated uses have one or more types of assessment that may be used to determine support. For example, to determine support for the other indigenous aquatic life or wildlife designated use, biological or physical/chemical assessment (e.g., rapid bioassessment of the macroinvertebrate community or chemical analysis of water samples) may be used. The assessment types include biological, habitat, physical/chemical, toxicological, pathogen indicators, other public health indicators, and other aquatic life indicators (default types from the USEPA ADB). In addition, a variety of parameters may be considered for the same assessment type. For example, physical/chemical assessments to determine fish consumption designated use support may include analysis of mercury concentration in fish tissue or PCB concentration in the water column.

Michigan uses the principle of independent applicability when making a support determination for each designated use for each water body. If data for more than one parameter are available that are used to determine support for the same designated use, then each data type is evaluated independently to determine support for the designated use. If any one type of data indicates that the designated use is not supported, then generally, the water body is listed as not supporting that designated use. In some instances, data require reevaluation to resolve discrepancies. Some particular data types or situations may require consideration of multiple

data types in combination. If no data are available for any assessment methods, then a water body is considered not assessed.

A single parameter may be used to make support determinations for more than one designated use. For example, appropriate data for a water body may reveal that water column mercury concentrations exceed the wildlife value and human noncancer value (HNV) (nondrinking water) (R 323.1057); therefore, both the other indigenous aquatic life and wildlife, and fish consumption designated uses are not supported. The inclusion of a parameter under a specific designated use in this assessment methodology does not preclude the use of that parameter to make support determinations for a different designated use.

Though infrequent, when best professional judgment (BPJ) is used to make a designated use support determination, justification is documented in the designated use comment field in the ADB record.

Water bodies listed as having insufficient information will generally be revisited in the correct basin year as resources allow (Figure 3.1). Comments specific to the development of each assessment are also accessible via the MiSWIMS (<http://www.michigan.gov/miswims>) by selecting the 'Designated Use' layer under the Map Search, choosing the designated use of interest as well as the category(ies) of interest, then using the "I"dentify Tool to bring up information linked directly from the ADB.

4.4 Designated Uses: Agriculture, Navigation, and Industrial Water Supply

4.4.1 Assessment Type: No Specific Indicator or Assessment Method

The MDEQ does not conduct specific assessments to evaluate support of the agriculture, navigation, and industrial water supply designated uses. These uses are assumed to be supported unless there is site-specific information indicating otherwise. In a scenario where site-specific information is used, the information is evaluated on a case-by-case basis using BPJ.

4.5 Designated Use: Warmwater Fishery and Coldwater Fishery

All surface waters of the state are designated and protected for warmwater fishery. In addition, specific rivers and inland lakes as well as all Great Lakes and specific Great Lakes connecting waters are designated and protected for coldwater fishery per R 323.1100(4)-(7).

4.5.1 Assessment Type: Physical/Chemical

For the following parameters the ideal dataset for assessments will come from continuous data collection or similar frequent collection over a target time frame. Collecting data of a sufficient frequency over an appropriate duration is important to fully investigate fluctuations in parameter quality over time and during critical periods (e.g., predawn and midday dissolved oxygen monitoring to investigate diurnal swings).

4.5.1.1 Dissolved Oxygen Concentration

Support determinations using dissolved oxygen data will typically be based on continuous data collected over a time period (e.g., two weeks) that is representative of conditions and captures environmental variability. Limited individual grab samples (e.g., 1 or 2 collected during other monitoring efforts) may generally be used only to assess a site as "insufficient information," thereby recognizing the need for more specific and detailed monitoring to make a use support determination. Data should be collected following current quality assurance procedures using

properly operating equipment maintained following manufacturer's guidelines. Consideration of environmental conditions (e.g., weather, sample collection time of day, etc.) is especially important when making designated use determinations using dissolved oxygen concentrations. In general, a decision of "not supporting" for dissolved oxygen will be based on a 10 percent exceedance threshold following USEPA guidance (USEPA, 2002). If more than 10 percent of representative measurements (with continuous monitoring being the preferred method) exceed the criteria set forth in R 323.1064 and R 323.1065, the site is listed as "not supporting." In addition to the guidelines outlined above (e.g., continuous monitoring preferred over a two-week period), BPJ remains a factor in any case of support determinations using ambient dissolved oxygen for the warmwater and coldwater fishery designated uses. It is conceivable, although likely infrequent, that in using BPJ, a water body may be assessed with a less rigorous set of data (e.g., than the preferred continuous monitoring over a two-week period), based on other environmental data concerns and/or multiple grab samples, showing degradation of water quality, collected over consecutive years or particularly egregious exceedance of WQS indicating obviously degraded conditions.

4.5.1.2 Temperature

Support determinations using temperature data will typically be based on continuous data collected over a time period (e.g., two weeks) that is representative of conditions and captures environmental variability. Limited individual grab samples (e.g., 1 or 2 collected during other monitoring efforts) may generally be used only to assess a site as "insufficient information," thereby recognizing the need for more specific and detailed monitoring to make a use support determination. Data should be collected using properly operating equipment maintained following manufacturer's guidelines. Consideration of environmental conditions (e.g. weather, sample collection time of day) is especially important when making designated use determinations using temperature. In general, a decision of "not supporting" for temperature will be based on a 10 percent exceedance threshold following USEPA guidance (USEPA, 2002). If more than 10 percent of representative measurements (with continuous monitoring being the preferred method) exceed the criteria set forth in R 323.1069, R 323.1070, R 323.1072, R 323.1073, or R 323.1075, depending on water body type, the site is listed as "not supporting." In addition to the guidelines outlined above (e.g., continuous monitoring preferred over a two-week period), BPJ remains a factor in any case of support determinations using ambient temperature for the warmwater and coldwater fishery designated uses. It is conceivable, although likely infrequent, that in using BPJ, a water body may be assessed with a less rigorous set of data (e.g., than the preferred continuous monitoring over a two-week period), based on other environmental data concerns and/or multiple grab samples, showing degradation of water quality, collected over consecutive years or particularly egregious exceedance of WQS indicating obviously degraded conditions.

4.5.1.3 Ammonia (un-ionized) Concentration

Support determinations of chronic conditions using un-ionized ammonia data will typically be based on grab sample data collected over a time period (e.g., one week) that is representative of conditions and captures environmental variability. Limited individual grab samples (e.g., 1 or 2 collected during other monitoring efforts) may generally be used only to assess a site as "insufficient information," thereby recognizing the need for more specific and detailed monitoring to make a use support determination. Consideration of other relevant parameters (e.g., temperature, pH, total ammonia) is especially important when calculating un-ionized ammonia concentration to make designated use determinations. In general, a decision of "not supporting" for un-ionized ammonia will be based on more than one exceedance of the monthly average (chronic) WQS per R 323.1057 over the period of review following USEPA guidance (USEPA, 1999).

Support determinations of daily maximum (acute) conditions using un-ionized ammonia data will be based on following USEPA guidance; when comparing ambient water column data to Aquatic Maximum Values, more than one exceedance of the acute un-ionized ammonia WQS over the period of review will typically result in assessing the site as not supporting (USEPA, 1999).

In addition to the guidelines outlined above, BPJ remains a factor in any case of support determinations using un-ionized ammonia for the warmwater and coldwater fishery designated uses. It is conceivable, although likely infrequent, that in using BPJ, a water body may be assessed with a less rigorous set of data (e.g., than the preferred continuous monitoring over a two-week period), based on other environmental data concerns and/or multiple grab samples, showing degradation of water quality, collected over consecutive years or particularly egregious exceedance of WQS indicating obviously degraded conditions.

4.5.1.4 pH

Support determinations using pH data will typically be based on continuous data collected over a time period (e.g., two weeks) that is representative of conditions and captures environmental variability. Limited individual grab samples (e.g., 1 or 2 collected during other monitoring efforts) may generally be used only to assess a site as “insufficient information,” thereby recognizing the need for more specific and detailed monitoring to make a use support determination. Data should be collected using properly operating equipment maintained following manufacturer’s guidelines. Consideration of environmental conditions (e.g., weather, sample collection time of day) is especially important when making designated use determinations using pH. In general, a decision of “not supporting” for pH will be based on a 10 percent exceedance threshold following USEPA guidance (USEPA, 2002). If more than 10 percent of representative samples (with continuous monitoring being the preferred method) exceed the criteria set forth in R 323.1053, the site is listed as “not supporting.” In addition to the guidelines outlined above (e.g., continuous monitoring preferred over a two-week period), BPJ remains a factor in any case of support determinations using pH for the warmwater and coldwater fishery designated uses. It is conceivable, although likely infrequent that in using BPJ, a water body may be listed with a less rigorous set of data (e.g., the preferred continuous monitoring over a two-week period), based on other environmental data concerns and/or multiple grab samples, showing degradation of water quality, collected over consecutive years or particularly egregious exceedance of WQS indicating obviously degraded conditions.

4.5.2 Assessment Type: Biological

4.5.2.1 Fish Community

In addition to chemical and physical assessment types, Michigan uses rapid bioassessment of fish communities in wadeable streams and rivers [generally Procedure 51 (P51) (MDEQ, 1990)] to determine support for the warmwater fishery and coldwater fishery designated uses. Fish community biosurvey sites are generally selected using targeted study designs.

Rivers and streams with no site-specific fish community biosurvey results are considered not assessed unless other data are available to assess this use as described elsewhere in this Section (4.5).

Using P51, warmwater fish communities are scored with metrics that rate water bodies from excellent (+5 to +10) to poor (-10 to -5). Fish ratings from -4 to +4 are considered acceptable (Creal et al., 1996). Water bodies with warmwater fish communities rating acceptable or excellent using P51 are determined to support the warmwater fishery designated use. Fish communities collected from designated coldwater streams using P51 are determined to support

the coldwater fishery designated use if the relative abundance of salmonids is equal to or greater than 1%. One bioassessment result is generally considered sufficient to make this determination.

Using P51, a determination of not supporting or, infrequently, insufficient information is made for water bodies that have metrics that rate the warmwater fish community poor, have coldwater fish communities with salmonid relative abundance of less than 1%, if fewer than 50 fish are collected, or if the relative abundance of fish with anomalies exceeds 2% (applies to both warmwater and coldwater fisheries). Generally, targeted biosurvey results should have sufficient supporting information available to determine survey representativeness and to list the water body as not supporting using one survey result. However, instances where other supporting information raise concerns over data quality and representativeness (e.g., a poor fish community result during high-water conditions or when equipment function was in question) may require the collection of additional information to determine data representativeness. In this case, a determination of insufficient information is made.

For fish communities that rate poor, current and past weather conditions, assessments of biological communities in adjacent stream or river segments, historic data, and the source and frequency of pollutant exposure are considered to determine if conditions are ongoing or temporary. If conditions are determined to be temporary, a water body may be listed as having insufficient information. For example, a water body with a temporarily poor biological community due to a short-term chemical spill may be listed as having insufficient information if remediation occurred and the community is expected to recover.

Fish community data for wadeable streams and rivers collected using methods other than P51 are evaluated on a case-by-case basis. For example, fish community data collected as part of the MDNR Fisheries Division's Status and Trend monitoring can be evaluated based on community structure and compared to the definitions for coldwater and warmwater fishery Use as stated in R 323.1043 and R 323.1044. When evaluating this information, two biologists independently assess fish community data relative to the definitions in the Rules and their assessments are subsequently compared. Assessments with agreement (e.g., both biologists rating the data as 'fully supporting' the fishery designated use) are used to assess the appropriate assessment unit as such. Assessments with disagreement (e.g., one biologist rating the data as 'fully supporting' while the other rates it as 'not supporting') result in discussions of the data and agreement reached or a rating as 'insufficient information' to generate additional data collection to fully assess the assessment unit in question.

Biological integrity data regarding instances where P51 is not appropriate (e.g., wetlands, lakes, ephemeral water bodies, nonwadeable rivers, etc.) will be evaluated on a case-by-case basis using BPJ. For example, one of the factors considered to determine support of the coldwater fishery designated use in coldwater lakes is the presence of indicator species such as cisco.

4.6 Designated Use: Other Indigenous Aquatic Life and Wildlife

4.6.1 Assessment Type: *Physical/Chemical*

4.6.1.1 *Water Column Toxic Substance Concentrations*

To determine other indigenous aquatic life and wildlife designated use support for toxic substances, ambient water column chemical concentrations are compared to Wildlife, Aquatic Maximum, and Final Chronic Values per R 323.1057 using Figure 4.1. Water chemistry monitoring sites are selected using both targeted and probabilistic study designs. All site-specific water column chemistry data are used to determine other indigenous aquatic life and wildlife designated use support.

A minimum of four data points are generally used to assess toxic substances per USEPA guidance (USEPA, 2002). In rare instances, limited data (less than 4 data points) demonstrating extreme exceedance of WQS may be used to assess a water body as not supporting; if so, the basis for these decisions will be reflected in the ADB.

Following USEPA guidance, when comparing ambient water column data to Aquatic Maximum Values, more than one exceedance of the WQS over the period of review will typically result in assessing the site as not supporting (USEPA, 2002). Comparisons of ambient water column data to Final Chronic Values will be made using geometric means of available data. Geometric mean is chosen to help interpret the central tendency of these water quality parameters given their general lognormal distribution.

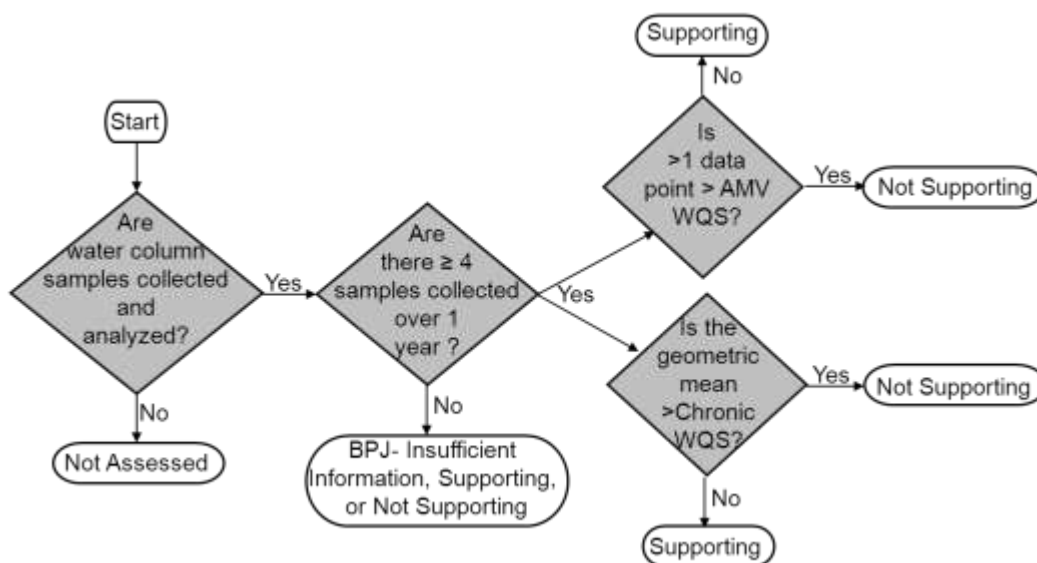


Figure 4.1. Determination of other indigenous aquatic life and wildlife and fish consumption designated uses support using water column toxic substance concentration.

4.6.1.2 Water Column Nutrient Concentrations

For all waters, ambient water column nutrient concentrations are used in conjunction with biological indicators to determine support of the other indigenous aquatic life and wildlife designated use in all surface waters per R 323.1060 using BPJ to interpret conditions related to this narrative standard. Samples collected during July through September, when the impacts due to nutrient expression are most likely to occur, are particularly important for making designated use support determinations. In addition, use support determinations will be influenced by excessive/nuisance algal and macrophyte growth (see Section 4.6.2.2.).

For inland lakes, Carlson's trophic status index (TSI) in conjunction with aquatic macrophyte surveys, are considered to determine designated use support. Individual TSI values are calculated using late summer data for each trophic state indicator: summer secchi depth (transparency), total phosphorus concentration (epilimnetic), and chlorophyll a concentration (photic zone) (Table 4.1). An overall TSI is determined from the mean of the individual TSI values to provide a way of reducing the effects of individual sampling and measurement errors, thus developing a more robust estimate of the index (Walker, 1979). Based on these index values the trophic status classification is determined as listed in Table 4.2. Carlson's index may underestimate the trophic state of lakes dominated by macrophytes. Therefore, the relative

abundance of submergent macrophytes is used to indicate more productive conditions than indicated by the TSI values. It is assumed that moderate and dense growths of macrophytes are indicative of mesotrophic and eutrophic conditions, respectively. Therefore, if Carlson's TSI indicate mesotrophic conditions, but dense macrophytes are present, the lakes will be classified eutrophic (MDNR, 1982). Inland lakes classified as oligotrophic, mesotrophic or eutrophic are generally determined to support the other indigenous aquatic life and wildlife designated use, unless other information exists regarding designated use impacts resulting from excess nutrients (e.g., persistent and significant algal blooms). Inland lakes that are classified as hypereutrophic, but without additional supporting information regarding nutrient expression, are generally listed as insufficient information with the goal of conducting additional, site specific, monitoring to confirm the trophic designation and whether impairments of the designated uses are realized

Table 4.1. Carlson's TSI Equations.	
$TSI_{SD} = 60 - 33.2 \log_{10}SD$	SD = Secchi depth transparency (m)
$TSI_{TP} = 4.2 + 33.2 \log_{10}TP$	TP = total phosphorus concentration (ug/l)
$TSI_{CHL} = 30.6 + 22.6 \log_{10}CHL$	CHL = chlorophyll a concentration (ug/l)

Table 4.2 Michigan Inland Lakes Trophic Status Classification Criteria.				
Trophic State	Carlson's TSI	TP (ug/l)	SD (m)	CHL (ug/l)
Oligotrophic	<38	<10	>4.6	<2.2
Mesotrophic	38-48	10-20	2.3-4.6	2.2-6
Eutrophic	48-61	20-50	0.9-2.3	6-22
Hypereutrophic	>61	>50	<0.9	>22

4.6.1.3 Physical Characteristics

R 323.1050 addresses the following physical characteristics of a water body: turbidity, color, oil films, floating solids, foams, settleable solids, suspended solids, and deposits. Michigan does not have specific assessment methods or numeric standards for these physical characteristics; therefore, BPJ (including visual observation) in conjunction with other assessment types (e.g., biological) is used to determine the other indigenous aquatic life and wildlife designated use support based on this narrative standard.

4.6.2 Assessment Type: Biological

4.6.2.1 Macroinvertebrate Community

In addition to chemical and physical assessment types, Michigan uses rapid bioassessment of macroinvertebrate communities in wadeable streams and rivers (generally P51; MDEQ, 1990) to determine support for the other indigenous aquatic life and wildlife designated use. Using P51, macroinvertebrate communities are scored with metrics that rate water bodies from excellent (+5 to +9) to poor (-5 to -9). Macroinvertebrate ratings from -4 to +4 are considered acceptable (Creal et al., 1996). Biosurvey sites are selected using both targeted and probabilistic study designs. All biosurvey data are considered to determine other indigenous aquatic life and wildlife designated use support.

Rivers and streams with no site-specific macroinvertebrate community biosurvey results are considered not assessed unless other data are available to assess the use as described elsewhere in this Section (4.6).

Water bodies with macroinvertebrate communities rating acceptable or excellent (i.e., total P51 macroinvertebrate community score -4 to +9) are determined to support the other indigenous

aquatic life and wildlife designated use. One bioassessment result is generally considered sufficient to make this determination.

A determination of not supporting or, infrequently, insufficient information is made for water bodies with macroinvertebrate communities rated poor (total P51 macroinvertebrate community score -5 to -9). Generally, targeted biosurvey results should have sufficient supporting information available to determine survey representativeness and to list the water body as not supporting using one survey result. For biological communities that rate poor, current and past weather conditions, relevant available historic data, assessments of biological communities in adjacent stream or river segments, and the source and frequency of pollutant exposure are considered to determine if conditions are ongoing or temporary (see Section 4.5.2.1). In all cases, the ADB reflects the information used to support the assessment decisions.

Macroinvertebrate data for wadeable streams and rivers collected using methods other than P51 are evaluated on a case-by-case basis. Similarly, biological integrity data regarding water bodies where P51 is not appropriate (e.g., wetlands, lakes, ephemeral streams, etc.) will be evaluated on a case-by-case basis using BPJ to assess community characteristics like taxa balance, diversity, and other indicators of system health and function.

Nonwadeable rivers are assessed using Michigan's Qualitative Biological and Habitat Survey Protocols for Nonwadeable Rivers (MDEQ, 2013a). Using this nonwadeable procedure, macroinvertebrate communities are scored with metrics that rate water bodies from excellent to poor. Macroinvertebrate ratings from 76-100 are considered excellent, 50-75 good, 25-49 fair, and 0-24 are considered poor.

Nonwadeable rivers with macroinvertebrate communities rating excellent, acceptable, or fair (i.e., total macroinvertebrate community score ≥ 25) are determined to support the other indigenous aquatic life and wildlife designated use. One bioassessment result is generally considered sufficient to make this determination.

Similar to determinations made for wadeable streams and rivers, a determination of not supporting or insufficient information is made for nonwadeable rivers with macroinvertebrate communities rated poor (total macroinvertebrate community score 0-24) depending on the quality and amount of supporting contextual information available.

4.6.2.2 Bacteria, Algae, Macrophytes, and Fungi

Site-specific visual observation of bacteria, algae, macrophytes, and fungi may be used to make a support determination for the other indigenous aquatic life and wildlife designated use. In addition, water column nutrient concentrations may also be used to support this determination (see Section 4.6.1.2).

A determination of not supporting will be made if excessive/nuisance growths of algae (particularly, *Cladophora*, *Rhizoclonium*, and cyanobacteria) or aquatic macrophytes are present. Although the determination of excessive, nuisance conditions is generally made using BPJ in accordance with narrative WQS, P51 offers the following guidance to make these determinations for streams:

- *Cladophora* and/or *Rhizoclonium* greater than 10-inches long covering greater than 25% of a riffle.
- Rooted macrophytes present at densities that impair the designated uses of the water body.
- Presence of bacterial slimes.

For inland lakes and impoundments, chlorophyll *a* (used as a surrogate for algal biomass) is a component of the TSI calculation and is used quantitatively to determine the trophic state (see Section 4.6.1.2).

4.7 Designated Use: Partial Body Contact Recreation and Total Body Contact Recreation

The partial body contact recreation designated use applies to all water bodies the entire year-while the total body contact recreation designated use applies to all water bodies during May 1 to October 31.

4.7.1 Assessment Type: Pathogen Indicators

4.7.1.1 *E. coli*

Michigan uses ambient *E. coli* concentration to determine partial body contact and total body contact recreation designated use support using Rule 323.1062 and following Figures 4.2a and 4.2b, respectively. A minimum of 5 sampling events “representatively spread over a 30-day period” are needed to fully assess the partial and total body contact recreation designated uses using *E. coli* data. A sampling event is defined by Rule 323.1062 as “three or more samples taken during the same sampling event at representative locations within a defined sampling area.” Larger datasets (e.g., weekly over the total body contact season or over multiple years) should be used to their fullest extent when available to assure that changing conditions during the year or over multiple years are adequately represented. A 10 percent exceedance threshold is targeted for making designated use determinations following USEPA guidance (USEPA, 2002). However, discretion may be used when considering a single violation and the magnitude of the exceedance under certain circumstances using small datasets (USEPA, 2002).

The representativeness of *E. coli* data is critical in assessing use attainment. It is important that the *E. coli* data used be spaced over time to represent a range of conditions rather than be clustered around a single event (e.g., single rain event or a single dry weather event). It is acceptable to sample during a critical 30-day period that may be driving *E. coli* concentrations (e.g., summer low flow, wet weather conditions) as long as they are distributed representatively over that time frame. Data used for reassessing an assessment unit previously listed as not supporting should, at a minimum, capture conditions that were reflected in the data used to make the initial assessment. For example, if wet weather events were captured as part of an initial dataset used to list an assessment unit as not supporting, it would be inappropriate to use only dry weather data to assess for delisting purposes. Additionally, when using more extensive datasets, the breadth of the data used is contingent on confidence that it represents conditions and variability typical of the water body being assessed.

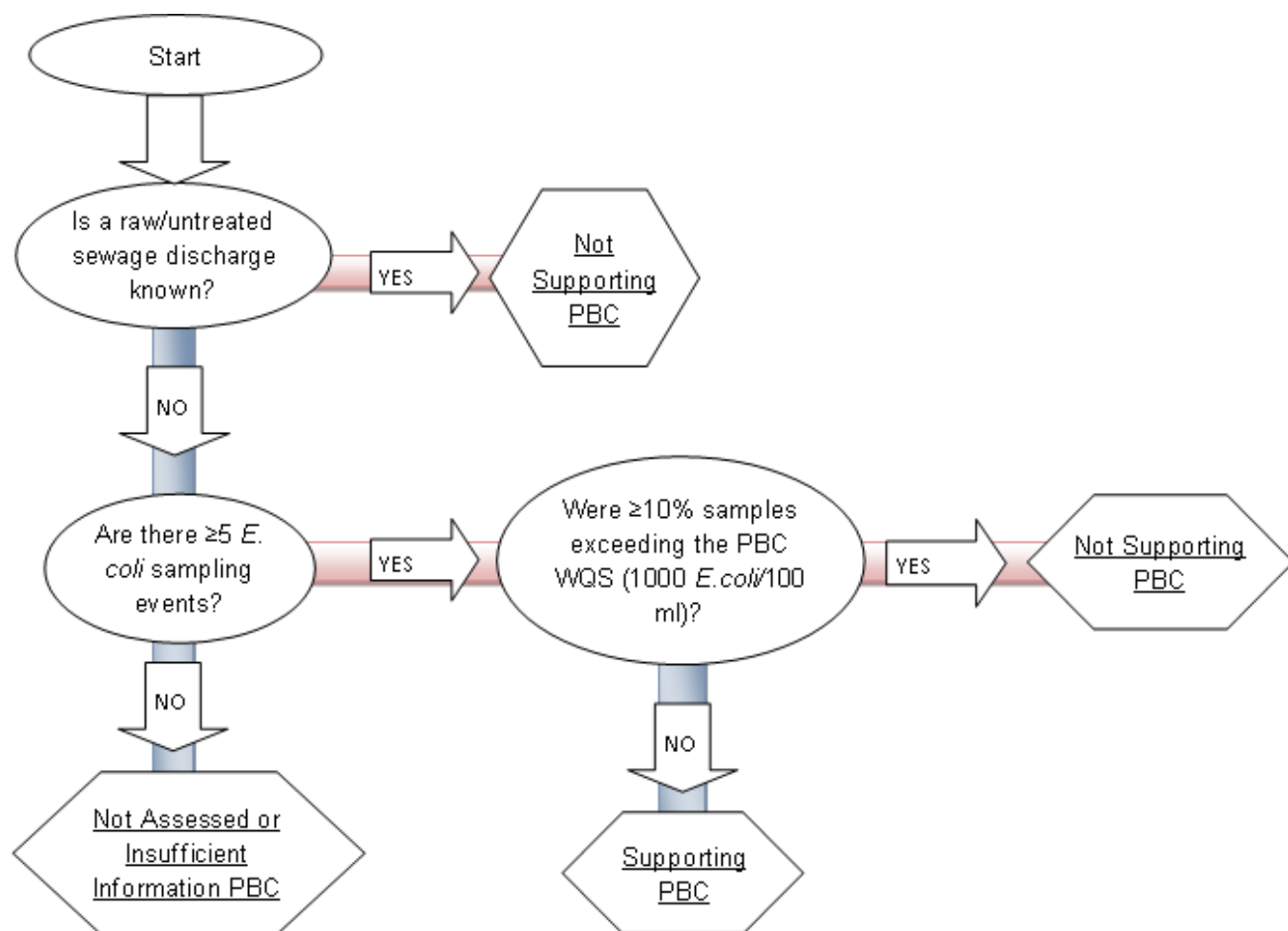


Figure 4.2a. Determination of partial body contact designated use support using ambient *E. coli* water column concentration. See Section 4.7.1.1 for additional details.

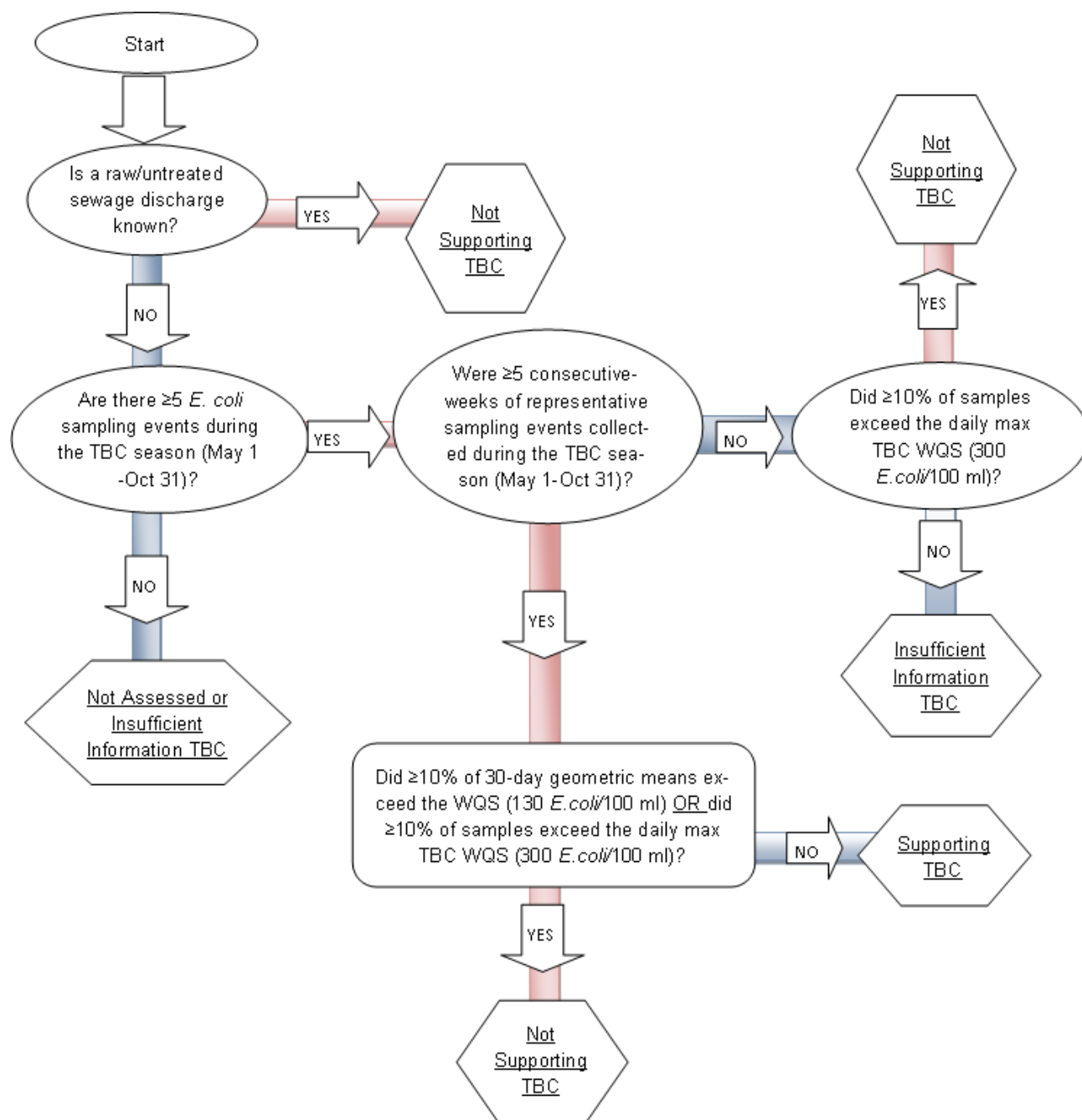


Figure 4.2b. Determination of total body contact designated use support using ambient *E. coli* water column concentration. See Section 4.7.1.1 for additional details.

4.7.2 Assessment Type: Physical/Chemical

4.7.2.1 pH

A determination of not supporting may be made in situations where the pH of surface water is such that direct human contact presents an opportunity for physical danger (e.g., contaminated groundwater venting from cement kiln dust disposal sites). Although infrequent, in such situations decision processes will be captured in relevant comment fields under affected Assessment Units within the ADB.

4.8 Designated Use: Fish Consumption

Michigan uses a variety of assessment types and parameters to determine fish consumption designated use support. Data considered include the concentration of bioaccumulative chemicals of concern (BCCs) (as listed in Table 5 of the Part 4 Rules) in the water column, fish tissue mercury concentration, and fish consumption advisories issued by the MDCH.

4.8.1 Assessment Type: Physical/Chemical

4.8.1.1 Water Column and Fish Tissue Mercury Concentrations

To be conservative, site-specific water column and fish tissue data are used together to determine fish consumption designated use support. Ambient water column mercury concentrations are compared to the HNV (nondrinking water) WQS (1.8 nanograms per liter [ng/L]); fish tissue mercury concentrations in edible portions are compared to Michigan's fish tissue value for mercury (0.35 milligrams per kilogram [mg/kg] wet weight).

Michigan's fish tissue mercury value development method is similar to the USEPA's development method for the national fish tissue criterion (USEPA, 2001). Michigan's fish tissue mercury value (0.35 mg/kg) was derived using the same exposure scenario used to derive Michigan's HNV (nondrinking water) WQS of 1.8 ng/L. Michigan's fish tissue value for mercury is the concentration that is not expected to pose a health concern to people consuming 15 grams or less of fish per day.

The fish tissue mercury value is not an ambient WQS; however, the MDEQ considers the direct use of fish tissue mercury data appropriate to help determine fish consumption designated use support. The use of fish tissue mercury data differs from that used for other contaminants (see Section 4.8.2.1) due to the lack of water body-specific advisories for mercury by the MDCH. Because the MDCH has issued statewide mercury advice, an alternate method of reviewing fish tissue mercury data was developed to facilitate the assessment of specific water bodies.

Fish consumption designated use support for mercury is determined by using Figure 4.3 to make a decision for water column mercury concentration, using Figure 4.4 to make a decision for fish tissue mercury concentration, and finally using Table 4.3 to determine overall fish consumption designated use support for mercury using the results from the Figures 4.3 and 4.4 decision processes. The overall designated use support for mercury determination from Table 4.3 is used for the Sections 305(b) and 303(d) reporting process. The geometric mean of the mercury water concentration data is used for this assessment because these data are expected to have a lognormal distribution.

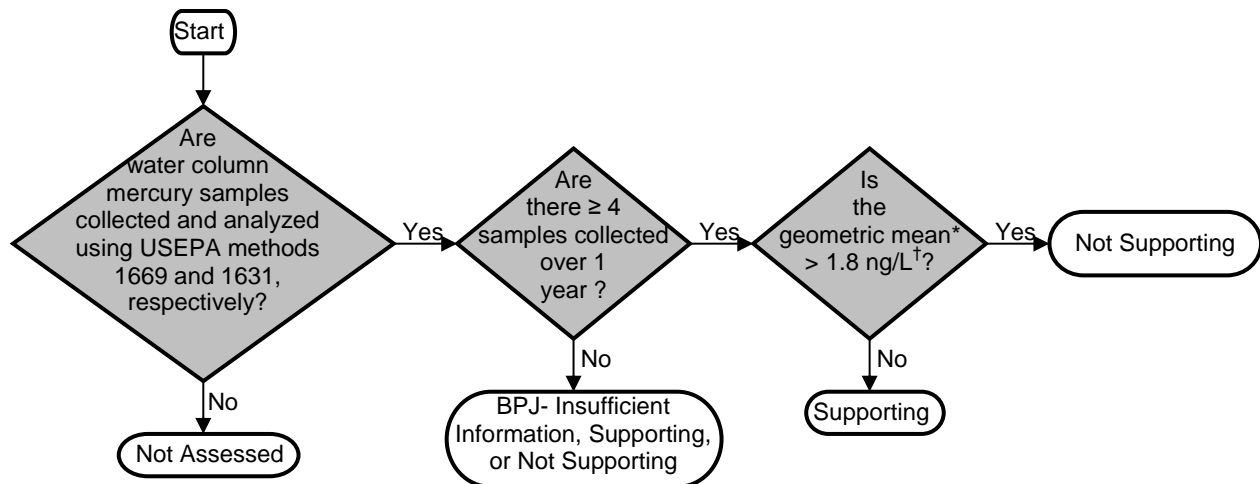


Figure 4.3. Determination of fish consumption designated use support using water column mercury concentration. This figure must be used in conjunction with Figure 4.4. The final overall fish consumption designated use support determination using mercury data is made using Table 4.3.

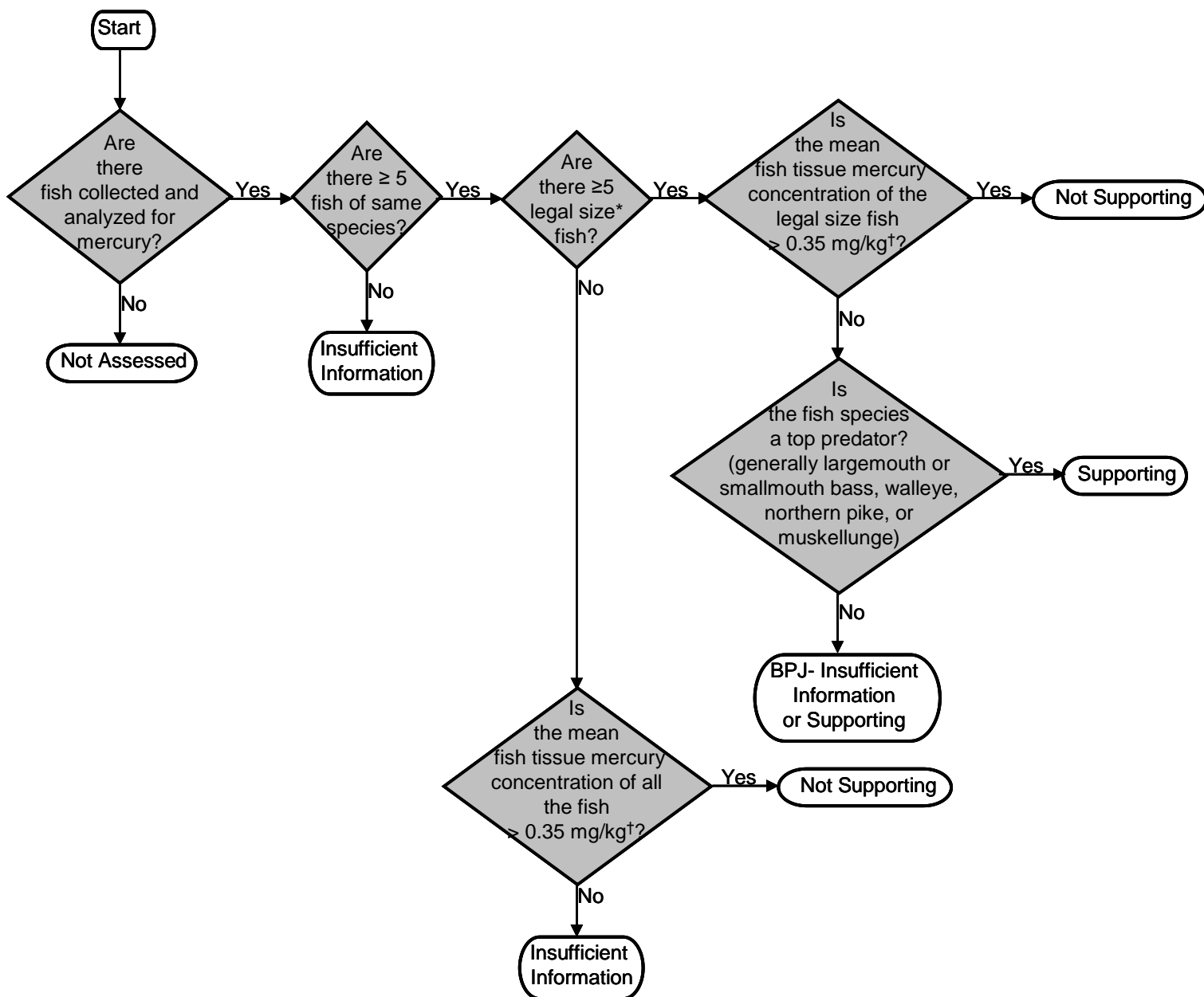


Figure 4.4. Determination of fish consumption designated use support using fish tissue mercury concentration. This figure must be used in conjunction with Figure 4.3. The final overall fish consumption designated use support determination using mercury data is made using Table 4.3.

* Legal size fish refers to the current minimum size limit regulations described in Michigan's Fishing Guide and Inland Trout and Salmon Guide published by the MDEQ.

† Michigan's fish tissue value for mercury.

Table 4.3. Overall fish consumption designated use support determination for mercury using water column and fish tissue mercury concentration.		
Decision based on mercury water column data (from Figure 4.3)	Decision based on mercury fish tissue data (from Figure 4.4)	Overall fish consumption designated use support for mercury
Supporting	Supporting	Supporting
Supporting	Not Supporting	BPJ*- Supporting, Not Supporting, or Insufficient Information
Supporting	Not Assessed/ Insufficient Information	Supporting
Not Supporting	Supporting	Not Supporting
Not Supporting	Not Supporting	Not Supporting
Not Supporting	Not Assessed/ Insufficient Information	Not Supporting
Not Assessed/ Insufficient Information	Supporting	Supporting
Not Assessed/ Insufficient Information	Not Supporting	Not Supporting
Not Assessed/ Insufficient Information	Not Assessed/ Insufficient Information	Not Assessed/ Insufficient Information

* In addition to the elements discussed in Section 4.2, the size and species of fish collected and analyzed, and the existence or potential for site-specific mercury fish consumption advisories, are considered when making designated use support decisions using BPJ.

4.8.1.2 Water Column PCB Concentration

To determine fish consumption designated use support for PCBs, the ambient water column PCB concentration is compared to the non-drinking water Human Cancer Value (HCV) (0.026 ng/L) (R 323.1057). PCB samples should be collected and analyzed according to protocols published by the USEPA (1997a and 1997b), with the exception that dissolved and particulate fractions are combined. For PCBs, a sample size of 1 is considered sufficient information to determine WQS nonattainment. This approach is justified by the existence of a large PCB dataset for the state as a whole, which shows virtually 100% exceedance of the HCV for total PCBs. If there are no appropriate PCB data, then a water body is considered not assessed. Water bodies with one or more ambient water column PCB sample results greater than the non-drinking water HCV are determined to not support the fish consumption designated use.

4.8.1.3 Water Column BCCs Concentration other than Mercury and PCBs

To determine fish consumption designated use support for BCCs other than mercury and PCBs in the water column, ambient water column chemical concentrations are compared to the HNV and HCV for nondrinking water per R 323.1057 using Figure 4.1 (see Section 4.6.1.1).

4.8.2 Assessment Type: Other Public Health Indicators

4.8.2.1 Fish Consumption Advisories for BCCs other than Mercury

For contaminants other than mercury, a water body is considered to not support the fish consumption designated use if the MDCH has issued a site-specific fish consumption advisory for that water body. The MDCH bases their advisories on fish tissue contaminant data collected

as part of the Michigan Fish Contaminant Monitoring Program. The fish tissue value is not an ambient WQS; however, the MDEQ considers the use of the MDCH advisory listing based on fish tissue data as appropriate for determining fish consumption designated use support. For example, a fish consumption advisory due to PCBs on a water body specific basis occurs when the median total PCB concentration in fillet samples of any species exceeds 0.05 mg/Kg (wet weight). Information specific to the MDCH fish consumption advisory issuance process can be found on the MDCH Web site (*under development*). The MDCH is developing advisory screening values for all fish contaminants.

4.9 Designated Use: Public Water Supply

Several specific segments or areas of inland waters, Great Lakes, Great Lakes bays, and connecting channels are designated and protected as public water supply sources [R 323.1100(8)].

4.9.1 Assessment Type: Physical/Chemical

4.9.1.1 Toxic Substances in Water Column

To determine public water supply designated use support for toxic substances other than BCCs, ambient water column chemical concentrations are compared to the HNV and HCV for drinking water per R 323.1057 using Figure 4.1 (see Section 4.6.1.1).

Public water supply designated use support determination for BCCs is problematic and there is generally insufficient information available to make a determination. The HNV and HCV for drinking water (surface WQS) calculations use an exposure scenario that includes human consumption of 15 grams of fish and two liters of water daily. The majority of human exposure to a BCC using this scenario would be from the consumption of fish. In other words, the relative human exposure to a BCC in surface waters via water consumption is minimal. Currently, Michigan's rules do not contain a methodology to derive human health values that protect solely for the consumption of two liters of untreated surface water per day. Maximum contaminant levels (MCLs), the maximum permissible level of a contaminant in water that is delivered to any user of a public water system, used by the MDEQ, Drinking Water Program, do not include a specific fish consumption component in the calculation.

Human Health WQS (HNV and HCV) for drinking water and MCLs are calculated differently and have different purposes. Due to the inconsistency between these values, comparisons of ambient water column BCC concentration to HNVs and HCVs for drinking water are not made. For example, the ambient PCB concentration at the point of a community water supply intake may exceed the PCB HCV drinking water value (0.026 ng/L) while the finished (i.e., treated) water may be determined to be below the PCB MCL (0.5 micrograms per liter [ug/L]).

4.9.1.2 Dissolved Solids

Designated use support determination using dissolved solids data is made on a case-by-case basis where one or more representative monthly average calculations can be made and compared to R 323.1051(2). With consistent ambient monitoring data (e.g., ambient drinking water intake data) the WQS will be considered not supporting the Public Water Supply designated use if more than 10 percent of samples during the period of review exceed the applicable WQS.

4.9.1.3 Taste and Odor

To determine public water supply designated use support, site-specific complaints of taste and odor causing substances in community source waters are considered on a case-by-case basis.

4.10 Assessment Units and Determination of Geographic Extent

Michigan uses the NHD coding scheme (1:24,000 resolution) to georeference water bodies when generating the Sections 305(b) and 303(d) lists. As a base assessment unit, Michigan uses 12-digit HUCs (Appendix A). The geographic extent of a designated use support determination for each water body is made on a case-by-case basis. The 12-digit HUC base assessment unit is used as a default when listing streams and rivers to facilitate record keeping and mapping. Each 12-digit HUC base assessment unit may be split into multiple assessment units if site-specific information supports a smaller assessment unit (e.g., contextual information such as land use, known areas of contamination, point source pollution location, specific fish consumption advisory geographic information, barriers such as dams that restrict fish migration, etc.). An assessment unit may consist of all water bodies in a 12-digit HUC (as a maximum) or specific stream segments or lakes in a 12-digit HUC.

Beyond using the 12-digit HUC as a base assessment unit, contextual information is considered when making a determination of the geographic extent that data collection points represent. For example, if a macroinvertebrate community survey conducted in the lower reach of a branch of a river indicates support of the other indigenous aquatic life and wildlife designated use and a second survey conducted farther upstream (several 12-digit HUCs upstream) in the same river branch also indicates designated use support, then contextual information may be considered to make a determination that the spanned river miles also support the designated use. In this example, contextual information may include similar physical habitat, similar land use, absence of point sources, absence of contaminated sites, etc. In other words, if contextual information indicates that it is appropriate, data collected from an assessment unit may be used to make designated use determinations for surrounding water body segments in different assessment units that lack data.

Generally, 12-digit HUCs are used as a base assessment unit for the public water supply designated use. For the public water supply designated use in inland intakes, the geographic extent of the assessment unit is the 12-digit HUC in which the intake is located.

For public water supply intakes that are located in the Great Lakes or connecting channels, a concept of a Critical Assessment Zone (CAZ) around each intake was developed based on a Sensitivity Factor calculated for each intake. The two attributes used to develop the Sensitivity Factor are the water depth above the intake structure and the perpendicular distance from shore or length of the intake pipeline. Other factors such as localized flow patterns, thermal effects, wind effects, lake bottom characteristics, benthic nepheloid layers, etc., may be used to complete the sensitivity analysis. A radius for the CAZ, ranging from 3,000 feet for the most sensitive intakes to 1,000 feet for the least sensitive intakes, is assigned based on the Sensitivity Factor. A shape with this radius is then drawn around the intake to illustrate the CAZ. If the CAZ intersects the shoreline, then the geographic extent of the assessment unit is determined on a case-by-case basis as the most influential 12-digit HUCs that are along the shoreline within the CAZ. For intakes that are located in open waters of the Great Lakes where the CAZ does not intersect the shoreline, the geographic extent of the assessment unit is 1.5 square miles.

Ultra low-level PCB monitoring conducted by the MDEQ indicates that PCB concentrations exceed the HCV WQS (0.026 ng/L) in all waters sampled. Based on these results, all river miles in the individual watersheds sampled for PCBs are listed as not supporting the fish consumption designated use for PCBs in the water column.

The geographic extent of some beaches is not currently available. In these instances, a geographic extent of 0.2 shoreline miles was used as a default value.

Streams and rivers are listed in terms of miles. Wetlands are listed in terms of acres. Generally, inland lakes are listed in their entirety as acres, and Great Lakes and bays are listed in terms of square miles, except for Great Lake and inland lake beaches, which are listed in terms of shoreline miles for pathogen concerns.

4.11 Assessment Unit Assignment to Categories

After support determinations for all designated uses and geographic extent decisions are made for an assessment unit, categories are assigned using a multiple category system. The following categories and subcategories are used:

Category 1: All designated uses are supported, no use is threatened.

Category 2: Available data and/or information indicate that some, but not all of the designated uses are supported.

Category 3: There is insufficient available data and/or information to make a designated use support determination.

Category 4: Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed.

Category 4a: A TMDL to address the impairment-causing pollutant has been approved or established by the USEPA.

Category 4b: Other approved pollution control mechanisms are in place and are reasonably expected to result in attainment of the designated use within a practical time frame.

Category 4c: Impairment is not caused by a pollutant (e.g., impairment is due to lack of flow or stream channelization).

Category 5: Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

An assessment unit is considered threatened and is placed in Categories 4 or 5 when water quality data analysis demonstrates a declining trend that is expected to cause that water body to not attain WQS by the next listing cycle (2016). An assessment unit is not attaining WQS when any designated use is not supported (i.e., Category 4 or 5). Assessment units placed in Category 5 form the basis for the Section 303(d) list and the TMDL development schedule (see Chapter 9 for additional information regarding TMDLs).

A few instances exist where the MDEQ has determined that assessment units do not support one or more designated uses, but other appropriate pollution control mechanisms are in place. These assessment units are placed in Category 4b. As described above, the pollution control mechanism for a Category 4b water body is expected to result in the attainment of the

designated use within a practical timeframe. Considerations to determine if a pollution control mechanism is appropriate to place a water body in Category 4b include, but are not limited to: the scale of the project (e.g., geographic extent affected, duration, etc.) and the anticipated level of impact on water quality. The MDEQ works closely with the USEPA to develop any new listings in Category 4b.

Assessment methodologies used for streams and rivers are also used for channelized streams, when appropriate, including rapid bioassessment of macroinvertebrate and fish communities according to the five-year rotating watershed cycle.

An assessment unit is listed in Category 4c when sufficient water quality data and information are available to determine all of the following:

- A specific designated use is not supported (e.g., the other indigenous aquatic life and wildlife designated use is not supported based on a P51 poor macroinvertebrate community rating).
- The cause of the designated use nonattainment is due to something other than a pollutant (e.g., channel maintenance activity or beaver dam).
- No pollutant would cause the designated use nonattainment if the above cause did not occur.

Assessment units are only placed in Category 4c when MDEQ monitoring staff determines (using P51 or other appropriate techniques) that sufficient water quality data and information are available to clearly indicate that the Category 4c listing requirements explained in the preceding paragraph fully apply.

Key factors considered by MDEQ monitoring staff to help differentiate whether pollutants or other causes are responsible for the observed nonattainment include: water/sediment chemistry and microbiological data when such data are available for the assessment unit, riparian land use characteristics, and P51 habitat metric scores, particularly those for the epifaunal substrate/available cover, embeddedness, sediment deposition, channel alteration, channel sinuosity, bank stability, bank vegetative protection, and riparian vegetative zone width metrics.

It should be noted that the MDEQ recognizes sediment to be a pollutant. If MDEQ aquatic biologists determine that a pollutant (including riparian sediment) is responsible for an assessment unit not supporting a designated use, then that assessment unit is listed in Category 5. Additionally, if channel modification activities in an upstream assessment unit result in sedimentation problems in a downstream assessment unit to a point which causes a designated use to not be supported, then that downstream assessment unit is listed in Category 5.

Michigan uses a multiple category system; therefore, placement of an assessment unit in Category 4c based on a determination that a designated use is not supported and the cause is not a pollutant does not preclude placement of that assessment unit in Category 5 (or any other category) based on a designated use support determination for a different designated use.

Assessment units that do not support a designated use due to multiple causes may be listed in multiple categories for that designated use. For example, an assessment unit may have a TMDL completed for sedimentation; therefore, the assessment unit is listed in Category 4a for

the other indigenous aquatic life and wildlife designated use. The same assessment unit may have a mercury TMDL scheduled but not yet completed; therefore, the assessment unit is also listed in Category 5 for the other indigenous aquatic life and wildlife designated use (see Table 4.4, Assessment Unit 10). In this case, the assessment unit is reported in both Categories 4a and 5 for the other indigenous aquatic life and wildlife designated use.

The following example (Table 4.4) adapted from USEPA guidance, illustrates Michigan's use of a multiple category system.

Table 4.4. Examples of assessment unit assignment to categories using a multiple category system with three designated uses. S = Supporting, NS = Not Supporting, - = Not Assessed, ? = Insufficient Information, / = Designated use does not apply to assessment unit. In designated use support summary tables (e.g., Tables 5.2, 5.3, 6.2, 7.2, and 8.1) Category 3 is reported as two subcategories: Insufficient Information and Not Assessed.

	Designated use A	Designated use B	Designated use C	Assigned Categories
Assessment Unit 1	S	S	S	1
Assessment Unit 2	NS	NS	NS	5
Assessment Unit 3	S	S	-	2, 3
Assessment Unit 4	S	S	?	2, 3
Assessment Unit 5	S	-	?	2, 3
Assessment Unit 6	S	NS (nonpollutant)	S	2, 4c
Assessment Unit 7	S	?	NS	2, 3, 5
Assessment Unit 8	S	NS (nonpollutant)	/	2, 4c, 3*
Assessment Unit 9	-	NS (TMDL approved)	NS	3, 4a, 5
Assessment Unit 10	-	NS (TMDL approved) NS	-	3, 4a, 5

* Currently designated uses that do not apply to an assessment unit are assigned not assessed in the ADB (e.g., coldwater fishery).

Justification for designated use support determination for each assessment unit is contained in the ADB. A comprehensive list of designated use support determinations is provided in Appendix B.

4.12 Impairment Cause and Source

When a determination is made that a designated use is not supported (i.e., an assessment unit is placed in Category 4 or 5), the cause and source of impairment are identified. Generally, the cause of impairment is the parameter(s) used to determine that the designated use is not supported unless a biological indicator is used. The source of impairment is determined using supporting contextual information and BPJ.

In addition, sediment toxic substance concentration data may be used to support other assessment types to make support determinations for the other indigenous aquatic life and wildlife, fish consumption, or other designated uses. Sediment data are collected from water bodies when there is direct knowledge or reasonable expectation of heavy metal or organic chemical contamination at levels that may impair biological communities by direct toxicity or cause fish consumption problems. Contaminated sediments may be listed as the source of impairment when sediment pollutant concentrations exceed screening concentrations (MacDonald et al., 2000; Jones and Gerard, 1999; and Ontario Ministry of the Environment, 1993) or when sediment toxicity test results demonstrate excessive toxicity.

4.13 Delisting Category 5 Assessment Units

Assessment units are removed from the Section 303(d) list (i.e., moved from Category 5 to another category) by the MDEQ using representative data and the current assessment methodology. Data analysis used to remove an assessment unit from the Section 303(d) list must be at least as rigorous a data analysis as was originally used to list the water body. Specific instances that justify the removal of assessment units from Category 5 include:

- A TMDL has been developed for all pollutants and approved by the USEPA (assessment unit is placed in Category 4a).
- A corrective, remediation action plan has been approved to be implemented or the problem source(s) has been removed, thereby, eliminating the need for a TMDL (assessment unit is placed in Category 4b or when water quality is reevaluated and it is determined that the designated use is supported, the assessment unit is placed in Category 2 or Category 1).
- The source of impairment for the initial designated use support determination was an untreated CSO and updated information reveals that the untreated CSO has been eliminated or control plan elements have been implemented in a legally binding document that includes a schedule for elimination of the untreated discharge but data are not yet available to document restoration (assessment unit is placed in Category 3 unless the corrective action program has not yet been completed, then it is placed in Category 4b).
- Reassessment of the assessment unit using updated monitoring data or information, techniques, or WQS, indicates that the water body now supports the designated use (assessment unit is placed in Category 1 or Category 2), or that additional monitoring or information is needed to determine whether the designated use is supported (assessment unit is placed in Category 3). For example, a water body may be moved from Category 5 to Category 3 if one year of new data indicated designated use support, but additional monitoring is needed to ensure continued designated use support.
- Reexamination of the monitoring data or information used to make the initial designated use support determination reveals that the decision was either incorrect or inconsistent with the current assessment methodology.
- Reassessment of a water body indicates that the cause of impairment is not a pollutant (assessment unit is placed in Category 4c).
- The assessment unit is determined to be within Indian Country, as defined in 18 U.S.C., Section 1151. These water bodies are not considered waters of the state of Michigan, and therefore, are not appropriate to include on the Section 303(d) list.

4.14 Assessment Methodology Changes

In addition to the minor edits and clarification changes made to update the 2012 assessment methodology for the 2014 IR, the following updates were made:

- Reworded and clarified assessment process in Section 4.5.1 to better describe desired minimum datasets and thresholds for assessment decisions using dissolved oxygen, temperature, ammonia (un-ionized), and pH data for the Warmwater Fishery and Coldwater Fishery designated uses.
- Reworded and clarified assessment process in Section 4.6.1.1 to better describe minimum datasets and thresholds for assessment decisions using water column toxic substance concentration data for the Other Indigenous Aquatic Life and Wildlife designated use.
- Clarification was added to Section 4.6.1.2 to better describe TSI calculation and how macrophyte density may be used to shift trophic classifications.
- Reworded the assessment process under Section 4.7.1.1 to better define the minimum data required and better align the assessment process made using various sources of *E. coli* data. The decision flow charts in Figures 4.2a and 4.2b were revised to reflect these changes.
- An Assessment Type was added under Section 4.7.2 to enable the use of pH data in assessing the Partial Body Contact Recreation and Total Body Contact Recreation designated uses.
- An Assessment Type was added under Section 4.9.1 to enable the use of dissolved solids data in assessing the Public Water Supply designated use, following Rule 323.1051(2).

CHAPTER 5

ASSESSMENT RESULTS: THE GREAT LAKES, BAYS, CONNECTING CHANNELS (ST. MARYS, ST. CLAIR, AND DETROIT RIVERS), AND LAKE ST. CLAIR

5.1 Trophic Status

Overall phosphorus loading reductions in the Great Lakes are attributable, in part, to effluent nutrient limits in NPDES permits issued to municipal and industrial facilities. For Great Lakes protection, Michigan's WQS restrict point source discharges of phosphorus to 1 milligram per liter

(mg/L) as a maximum monthly average. Lower limits may be, and often are, imposed to protect designated uses in receiving or downstream waters.



Legislation passed in 1977 that reduced the allowable phosphorus content in household laundry detergents sold in Michigan to less than 0.5% phosphorus by weight has contributed to the reduction of phosphorus discharged from point sources. Legislation passed in 2009 reduced the allowable phosphorus content in any cleaning agent sold in Michigan intended for use in household clothes washing machines and, beginning July 1, 2010, dishwashers to 0.5% by weight expressed as elemental phosphorus. This legislation further reduces phosphorus loads from wastewater treatment plants and on-site treatment systems. NPS phosphorus reduction efforts have also contributed to improved Great Lakes water quality and was aided by legislation that went into effect in 2012 banning the use of phosphorus-containing lawn fertilizers. The current trophic status of each of Michigan's Great Lakes is presented in Table 5.1.

Table 5.1 Trophic status of the Great Lakes bordering Michigan.

Lake	Trophic Status (nutrient level)
Superior	Oligotrophic* (low)
Huron	Oligotrophic* (low)
Saginaw Bay	Eutrophic [†] (high)
Michigan	Oligotrophic* (low)
Erie (Central Basin)	Oligotrophic/mesotrophic* (moderate)
Western Basin	Mesotrophic* (moderate)

*USEPA, 2011a; [†]USEPA, 2011b

5.2 Water Chemistry of the Great Lakes Connecting Channels

Quality assured data through 2011 were used for assessment updates for this reporting cycle. However, only data through 2008 was available for discussions of broader trends and results around Michigan as analyzed in the most recent Water Chemistry Monitoring Program report. Great Lakes connecting channel (St. Marys, St. Clair, and Detroit Rivers) monitoring efforts and results from 1998 through 2008 are summarized in the report released in 2013 (MDEQ, 2013b). Additional annual reports prepared by the Great Lakes Environmental Center (GLEC) under contract with the MDEQ were used to provide this summary (most recent reports - GLEC, 2006a

and 2007a). Key findings from water chemistry monitoring of the three Great Lakes connecting channels bordering Michigan (Detroit, St. Clair, and St. Marys Rivers) follow:

- Detroit River nutrient concentrations have decreased significantly since the late 1960s, with an order-of-magnitude decline in total phosphorus concentrations from a high of 0.13 mg/L in 1969. Data collected between 1998 and 2008 indicate seasonal fluctuations in nitrogen parameters, with an overall increase in median total phosphorus concentration upstream to downstream although inconsistent year-to-year and with no trend in changes over time. Mercury and trace metals data (chromium, copper, and lead) obtained from 1999 to 2008 found no changes over this time period. In general, statistically significant differences ($p < 0.05$) between upstream and downstream concentrations were not apparent, with the exception of mercury, which was significantly higher at the upstream station.
- St. Clair River total phosphorus concentrations showed a decreasing trend at the upstream station from 1998 to 2008 and median concentrations were higher downstream versus upstream. Mercury and trace metals data (chromium, copper, and lead) obtained from 1999 to 2008 indicate no trends. Spatial analyses indicate that chromium, copper, lead, and mercury concentrations increased from upstream to downstream.
- Little historic water chemistry data are available for the St. Marys River, but data obtained from 1998 to 2008 indicate no trends for nutrients or trace metals (mercury, chromium, copper, and lead). Total phosphorus concentrations increased from upstream to downstream, as did chromium, copper, lead, and mercury concentrations.

5.3 Water Chemistry of Saginaw Bay and Grand Traverse Bay

Quality assured data through 2011 were used for assessment updates for this reporting cycle. However, only data through 2008 was available for discussions of broader trends and results around Michigan as analyzed in the most recent Water Chemistry Monitoring Program report. Saginaw Bay and Grand Traverse Bay monitoring efforts and results from 1999 through 2008 are summarized in the report released in 2013 (MDEQ, 2013b). Additionally, annual reports prepared by the GLEC under contract with the MDEQ were used to prepare this summary (most recent reports - GLEC, 2006b and 2007b). Key findings from water chemistry monitoring of Saginaw and Grand Traverse Bays are summarized below.

- Saginaw Bay total phosphorus concentrations remain relatively constant with annual median concentrations between 0.015 and 0.019 mg/L (except 0.013 mg/L in 2005) and mean concentrations between 0.015 and 0.021 mg/L; generally above the target total phosphorus concentration of 0.015 mg/L established by the “Michigan Phosphorus Reduction Strategy for the Michigan Portion of Lake Erie and Saginaw Bay” (MDNR et al., 1985). The overall median chlorophyll *a* concentration (using all years, months, and stations) was 5.65 ug/L with individual values ranging from 35 ug/L to 1 ug/L at the various monitoring locations. The highest median chlorophyll *a* value at an individual monitoring station was 7.7 ug/L. Chlorophyll *a* showed seasonal variability with levels during August, September, and October higher than other months.
- Grand Traverse Bay nutrient, chlorophyll *a*, and water clarity data reflect oligotrophic conditions and excellent water quality. During 1998-2008, the bay-wide median total phosphorus and chlorophyll *a* concentrations in Grand Traverse Bay were 0.005 mg/L and 1.55 ug/L, respectively.

- Comparison of recent Saginaw Bay and Grand Traverse Bay trace metals and mercury water chemistry data with applicable Michigan WQS showed that average mercury concentrations in both bays met the mercury Rule 57 water quality value of 1.3 ng/L. All mean concentrations of chromium, copper, and lead at all sampling locations in Grand Traverse Bay and Saginaw Bay met applicable Rule 57 water quality values.

Saginaw Bay and Grand Traverse Bay monitoring efforts continue and will continue to be summarized in reports with connecting channels (see Section 5.2) and rivers and streams (see Section 7.2), every 3-5 years.

5.4 Fish Contaminants

Several projects have been implemented in the Great Lakes basin to monitor temporal and spatial trends in fish contaminant levels:

- The USEPA, Great Lakes National Program Office, collects and analyzes whole lake trout from the open waters of Lakes Superior, Michigan, Huron, and Ontario, and walleye from Lake Erie.
- The federal-state coordinated fillet trend monitoring program collects and analyzes chinook and coho salmon from Lakes Superior, Michigan, and Huron, and rainbow trout from Lake Erie. This program was discontinued as of 2009.
- Michigan's whole fish contaminant trend monitoring effort, initiated in 1990, focuses on fish collected from ten fixed stations located in the Great Lakes bays and connecting channels.

The USEPA lake trout data for Lakes Superior, Michigan, Huron, and Ontario indicate that total PCB and DDT concentrations in all four lakes declined between the 1970s and 2000. Also, Lake Michigan lake trout had higher levels of total PCBs and total DDT than lake trout from the other Great Lakes. Concentrations of most contaminants in Lake Superior lake trout were lower than concentrations from the other Great Lakes. The USEPA walleye data for Lake Erie indicate that total PCB and DDT concentrations declined since 1977. Additional results and general conclusions from the USEPA lake trout and walleye data and the federal-state chinook and coho salmon fillet trend monitoring, including information regarding PCBs, DDT, chlordane, and toxaphene concentrations, are presented in the Michigan Fish Contaminant Monitoring Program: 2008 Annual Report (Bohr and VanDusen, 2009).

In 1990, Michigan initiated a fixed station fish contaminant trend monitoring project to measure spatial and temporal trends of certain bioaccumulative contaminants. Trend stations in Great Lakes waters are located in Keweenaw Bay (Lake Superior), Little Bay de Noc and Grand Traverse Bay (Lake Michigan), Thunder Bay and Saginaw Bay (Lake Huron), Lake St. Clair, Brest Bay (Lake Erie), and in the St. Marys, St. Clair, and Detroit Rivers. Adult fish are collected from each site at a target interval of two to five years, and analyzed as whole fish samples. Whole fish fixed station trend monitoring data collected between 1990 and 2011 were reviewed and general trend conclusions for the Great Lakes and connecting channels are summarized below:

- Lindane, terphenyl, polybrominated biphenyl (PBB), heptachlor, and aldrin were not quantified in any of the fish sampled. However, heptachlor epoxide and dieldrin

(breakdown products of heptachlor and aldrin) were quantified in most of the samples analyzed.

- In addition to heptachlor epoxide and dieldrin, several chemicals were quantified in fish consistently, indicating that they are ubiquitous in the aquatic environment. These include mercury, hexachlorobenzene, total PCB, total chlordane, and total DDT.
- Apparent toxaphene was found primarily in walleye and lake trout from the Great Lakes and connecting channels. The highest concentrations of apparent toxaphene were quantified in lake trout from Lake Superior.
- All species from the Great Lakes and connecting channels tended to have higher concentrations of chlorinated organic contaminants than the same species from inland lakes.
- Carp and walleye from the St. Marys River had lower concentrations of organic contaminants than carp from Lake St. Clair and the Detroit River. Carp and walleye from the St. Marys River had higher concentrations of mercury than carp and walleye from Lake St. Clair and the Detroit River.
- Total PCB, DDT, and chlordane concentrations have declined at all 10 Great Lakes and connecting channel trend sites, with declines averaging 7%, 9%, and 10% per year, respectively.
- Trends in dioxin toxicity equivalence concentrations have been monitored in lake trout from Lake Superior (Keweenaw Bay), Lake Michigan (Grand Traverse Bay), and Lake Huron (Thunder Bay), and in carp from Lake Huron (Saginaw Bay). Dioxin concentrations have declined at the Lake Superior, Lake Michigan, and Thunder Bay sites, with an average decline of 9% per year since the early 1990s.
- Mercury concentrations have increased in at least one species of fish monitored from Little Bay De Noc and Grand Traverse Bay in Lake Michigan, Saginaw and Thunder Bays in Lake Huron, Lake Erie, and Lake St. Clair. No change was measurable in samples from Lake Superior or the St. Marys River. Mercury concentrations in carp from the Detroit River have declined 7% per year since 1990.

In addition, edible portion fish tissue contaminant monitoring was conducted in 2010 in Little Bay De Noc (northern Lake Michigan), the St. Clair River, Lake St. Clair, and the Detroit River. In 2011 edible portion samples were collected from Lake St. Clair, the Detroit River, and western Lake Erie. Fish tissue samples from top predators in these water bodies all had elevated mean mercury concentrations indicating the fish consumption designated use was not supported. Edible portion sampling is often targeted toward known sites of contamination, sites popular with sport anglers, and sites with public access.

5.5 Beaches

In 2011, 254 public beaches (owned by a city, county, etc.) on the Great Lakes were monitored and 161 reported no exceedances of the *E. coli* WQS for total body contact. There were 93 beaches that reported a total of 215 exceedances.

In 2012, 252 public beaches were monitored and 168 reported no exceedances of the *E. coli* WQS for total body contact. There were 84 beaches that reported a total of 161 exceedances.

The Michigan Beach Web site (<http://www.deq.state.mi.us/beach>) provides access to a database containing beach closings and *E. coli* data collected by LHDs. Currently, 604 public beaches located along the Great Lakes are listed in the database; although, water quality data are not available for all beaches. Data for Great Lakes beaches in Michigan are also available at <http://watersgeo.epa.gov/beacon2/>.

5.6 Decaying Organic Matter Deposits

Deposits of dead and decaying organic matter continue to periodically foul beaches along Michigan's Great Lakes shoreline including, but not limited to, Grand Traverse Bay, Saginaw Bay, and western Lake Erie. While increased aquatic vegetation growth is typically associated with elevated nutrient concentrations, many of the shoreline deposits are occurring where ambient phosphorus and nitrogen concentrations are very low or declining. Similar problems are being reported along the Wisconsin Lake Michigan shoreline, the Ohio and Pennsylvania Lake Erie shoreline, and the New York Lake Ontario shoreline, where, like Michigan, shorelines are being fouled by decaying organic matter that may interfere with the enjoyment of beaches and nearshore waters.

Once thought to be caused primarily by the presence of excessive nutrients (phosphorus), there is growing evidence that the increased organic matter deposits may be the result of a complex interaction between nutrients and exotic mussel species (Hecky et al., 2004), changes in wind patterns over the Great Lakes (Waples and Klump, 2002), and fluctuating water levels (Harris, 2004). Research is ongoing to identify the causes and sources for these shoreline deposits with the hope that effective solutions can be found. Although phosphorus concentrations do not appear to be solely responsible for the shoreline deposits, programs and policies intended to reduce phosphorus in all waters of the state remain important components of efforts to improve and protect water quality.

The MDEQ has been and will continue to work with the research community, other governmental agencies, and the public toward an understanding of the causes/sources responsible and a solution to the shoreline deposit problem. For example, at the time of drafting this document the Saginaw Bay Multiple Stressors project, begun in 2008 and spearheaded by the NOAA Great Lakes Environmental Research Laboratory, was in the process of releasing final reports and special publications to communicate findings from this extensive research and modeling effort, of which a large component focuses on beach "muck." It is anticipated that this information will better inform management efforts and expectations with regard to, among other things, decaying organic matter deposits in the Saginaw Bay area and possibly be relevant elsewhere.

5.7 Designated Use Support Summary

Designated use support summaries for Michigan waters of the Great Lakes, bays, connecting channels, and Lake St. Clair are presented in Tables 5.2 and 5.3. Michigan uses a multiple category system (i.e., assessment units may be placed in one or more category, see Section 4.11); therefore, Great Lake square miles and Great Lake shoreline miles and connecting channel miles are not totaled. Key designated use support results for Michigan waters of the Great Lakes, connecting channels, and Lake St. Clair follow. Impairment cause and source information for assessment units not supporting designated uses is presented in Chapter 9.

- Considerable progress has been made to eliminate untreated CSO discharges to the Great Lakes connecting channels. The majority of the St. Clair River, 33.3 miles, supports the total body contact and partial body contact recreation designated uses. A small portion of the St. Clair River, 7.5 miles located from Marysville upstream to Lake Huron, is listed in Category 4b. Untreated CSOs remain in the city of Port Huron. CSO elimination is scheduled for completion by 2016. An *E. coli* TMDL was completed for the Detroit River in 2008; therefore, these 25.7 miles are listed in Category 4a. Some untreated CSO discharges still exist; consequently, the upper 16 miles of the St. Marys River miles are listed as not supporting the total body contact and partial body contact recreation designated uses.
- The Michigan waters of the Great Lakes, their connecting channels, Saginaw and Grand Traverse Bays, and Lake St. Clair are listed as not supporting the fish consumption designated use due to elevated concentrations of PCBs, DDT, mercury, chlordane, and/or dioxin. Atmospheric deposition is considered to be the major source of these persistent bioaccumulative chemicals.
- Water chemistry results indicate that all 125 Great Lakes connecting channel miles are not supporting the fish consumption and other indigenous aquatic life and wildlife designated uses due to elevated concentrations of PCBs in the water column. The primary source of PCBs is atmospheric deposition. Mercury concentrations in the St. Marys and St. Clair Rivers are usually below the 1.3 ng/L WQS, but mercury concentrations in the Detroit River often exceed 1.3 ng/L.
- Deposits of decaying organic matter along some Great Lakes shorelines continue to be a significant problem and may interfere with beach recreational use and access to the water in some places along Saginaw Bay and western Lake Erie. Microorganisms have been identified in the decaying matter; however, the standards apply only to ambient water. Water quality is routinely monitored at Saginaw Bay beaches, western Lake Erie beaches, as well as other Great Lakes shoreline beaches around the state and areas where WQS are exceeded are listed as not supporting the total and/or partial body contact recreation designated use and a TMDL is scheduled according to the assessment methodology.

The WQS require that nutrients be limited to the extent necessary to prevent stimulation of plant/algae growths that are or may become injurious to the designated uses. However, it is widely believed that nutrients are only one of the many factors contributing to this problem and the relative importance of nutrients compared with other causes is unclear. The presence of the shoreline deposits where phosphorus concentrations are significantly less than those in Saginaw Bay (e.g., Grand Traverse Bay and Lake Michigan's eastern shore) indicate that this is a legitimate question.

The WQS also require that the state's surface waters not have any "deposits" in "unnatural quantities which are or may become injurious to any designated use." Deposits of decaying organic material occur naturally in aquatic systems, and are frequently observed along the Great Lakes and inland lakes.

A careful evaluation of available data and scientific information, and a comparison against WQS reveals that there is insufficient information to determine whether designated uses are not supported as a result of the decaying organic matter. Consequently, 142 miles of Saginaw Bay and 37.5 miles of western Lake Erie shoreline

are listed as having insufficient information to determine support of the total and partial body contact recreation designated uses. In addition, 1,262 square miles of Saginaw Bay and western Lake Erie are listed as having insufficient information to determine support of the other indigenous aquatic life and wildlife designated use.

Table 5.2 Designated use support summary for the Great Lakes, bays, and Lake St. Clair (approximately 42,167 square miles / 3,065 shoreline miles). No Great Lakes and bays are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture (mi ² / shoreline mi)*	42,167 / 2,886	0	0 / 180	0	0	0	0
Navigation (mi ² / shoreline mi)*	42,167 / 2,886	0	0 / 180	0	0	0	0
Industrial Water Supply (mi ² / shoreline mi)*	42,167 / 2,886	0	0 / 180	0	0	0	0
Warmwater Fishery (mi ²)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Coldwater Fishery (mi ² / shoreline mi)*	0	0	42,167 / 3,327	0	0	0	0
Other Indigenous Aquatic Life and Wildlife (mi ² / shoreline mi)* [†]	280 / 4.2	1,262 / 55	40,625 / 3,255	0	0	0	0
Partial Body Contact Recreation (shoreline mi) [†]	70.6	196.3	3,057	0.5	0	0	3.2
Total Body Contact Recreation (shoreline mi) [†]	58.1	205.8	3,057	0.8	0	0	5.8
Fish Consumption (mi ² / shoreline mi)*	0	0	0 / 0	0	0	0	42,167 / 3,065
Public Water Supply (mi ²) [‡]	1.5	13.5	58.5	0	3	0	0

* Geographic extent may be reported in two different measurement units for this designated use (square miles (mi²)/shoreline mi). These values represent different assessment units (i.e., shoreline miles do not correspond to the mi² listed).

[†] These designated uses apply to all surface waters of the state; however, these particular values represent shoreline miles/beaches. Not all designated uses have been assessed for all shoreline miles.

[‡] Approximately 76.5 mi² of the Great Lakes and bays are protected for the public water supply designated use.

N/A indicates that the designated use is not applicable.

Table 5.3 Designated use support summary for the Great Lakes connecting channels (St. Marys, St. Clair, and Detroit Rivers) in Michigan (approximately 125 total miles). No connecting channels are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture (mi)	125	0	0	0	0	0	0
Navigation (mi)	125	0	0	0	0	0	0
Industrial Water Supply (mi)	125	0	0	0	0	0	0
Warmwater Fishery (mi)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Coldwater Fishery (mi)	0	0	125	0	0	0	0
Other Indigenous Aquatic Life and Wildlife (mi)	0	0	0	0	0	0	125
Partial Body Contact Recreation (mi)	75.3	0	0	25.7	7.5	0	16
Total Body Contact Recreation (mi)	75.3	0	0	25.7	7.5	0	16
Fish Consumption (mi)	0	0	0	0	0	0	125
Public Water Supply (mi) *	0	2	3	0	0	0	0

* Approximately 5 of the 125 connecting channel miles are protected for the public water supply designated use.

N/A indicates that the designated use is not applicable.

CHAPTER 6

ASSESSMENT RESULTS: INLAND LAKES AND RESERVOIRS

6.1 Trophic Status

Carlson's TSI is used by the MDEQ to assess and classify Michigan's 730 public access lakes (see Section 1.2.2). This classification system is based on an index derived from a combination of four field measurements: (1) summer Secchi depth (transparency); (2) total phosphorus concentration (epilimnetic); (3) chlorophyll *a* concentration (photic zone), and (4) macrophyte abundance. The numerical value of the index increases as the degree of eutrophication increases. Historically, inland lake monitoring efforts have been directed toward obtaining baseline data for all 730 public access lakes.



The MDEQ and USGS completed a cooperative project in 2010 that sampled 730 public access inland lakes greater than 25 acres as part of the Lake Water Quality Monitoring Assessment Project. The majority (72%) of Michigan's public access lakes that were sampled from 2001 through 2010 have moderate (mesotrophic) or low (oligotrophic) nutrient levels (Table 6.1) (Fuller and Taricska, 2012).

Table 6.1 Trophic status summary of Michigan's public access lakes sampled from 2001 through 2010 (N=730).

Trophic Status	Number of Lakes
Oligotrophic (low nutrients)	129 (18%)
Mesotrophic (moderate nutrients)	399 (54%)
Eutrophic (high nutrients)	174 (24%)
Hypereutrophic (excessive nutrients)	28 (4%)

During 2011 and 2012, over 200 lakes were sampled each year as part of the Cooperative Lakes Monitoring Program, under the Michigan Clean Water Corps (for additional information see <http://www.micorps.net>). During 2011, 105 of these lakes were sampled for the three primary trophic status indicators (Secchi depth, total phosphorus, and chlorophyll *a*). Of these lakes, 49 were classified as oligotrophic, 44 mesotrophic, 12 eutrophic, and 0 were hypereutrophic. During 2012, 108 lakes were sampled for all three primary trophic status indicators and 47 were classified as oligotrophic, 49 mesotrophic, 12 eutrophic, and 0 were hypereutrophic.

6.2 Fish Contaminants

In 1990, Michigan initiated a fixed station fish contaminant trend monitoring project to measure spatial and temporal trends of certain bioaccumulative contaminants. Adult fish are collected from each site at a target interval of two to five years, and analyzed as whole fish samples. Fish have been collected from seven inland lakes (Gogebic, South Manistique, Higgins, Houghton, Gun, Gull, and Pontiac) as part of the fish contaminant trend monitoring project. Whole fish

fixed station trend monitoring data collected since 1990 were reviewed and general trend conclusions for inland lakes are summarized below:

- Lindane, terphenyl, PBB, heptachlor, and aldrin were not quantified in any of the fish sampled. However, heptachlor epoxide and dieldrin (breakdown products of heptachlor and aldrin) were quantified in most of the samples analyzed.
- In addition to heptachlor epoxide and dieldrin, several chemicals were quantified in fish consistently, indicating that they are ubiquitous in the aquatic environment. These include mercury, hexachlorobenzene, total PCB, total chlordane, and total DDT.
- Fish from inland lakes tended to have higher concentrations of mercury than the same species from the Great Lakes or connecting channels.
- Total PCB concentrations declined at all of the inland lake trend sites monitored since 1990, with an average decline of 8% per year.
- Total DDT concentrations declined at all of the inland lake trend sites monitored since 1990, with an average decline of 7% per year.
- Total chlordane concentrations declined at all of the inland lake trend sites where a trend could be detected, and the average decline was 10% per year. No trend was detected at 2 inland lakes because chlordane concentrations were consistently below the analytical quantification level.
- Significant trends in mercury concentrations have been detected at 3 of the 7 inland lake trend sites. Mercury concentrations in walleye from Lake Gogebic declined 5% per year between 1991 and 2009, declined in largemouth bass from Gull Lake at a rate of 2% per year between 1991 and 2009, and increased 4% per year in lake trout from Higgins Lake between 1991 and 2011.

In addition, edible portion fish tissue contaminant monitoring was conducted in 2010 and 2011 at 32 inland lakes and reservoirs. Edible portion sampling is often targeted toward known sites of contamination, sites popular with sport anglers, and sites with public access. Results of the edible portion monitoring are used by the MDEQ in determining the status of the Fish Consumption designated use for a given water body. Of the 32 locations monitored in 2010 and 2011, 27 (84%) were assessed as not supporting the Fish Consumption designated use, while 5 (16%) were found to be fully supporting the same use. The edible portion fish tissue results are also used by the MDCH to update fish consumption advisories.

6.3 Beaches

In 2011, a total of 146 public beaches (owned by a city, county, etc.) on inland lakes were monitored and 126 had no exceedances of the *E. coli* WQS for total body contact. There were 20 beaches that reported a total of 36 exceedances.

In 2012, a total of 203 public beaches on inland lakes were monitored and 164 had no exceedances of the *E. coli* WQS for total body contact. There were 39 beaches that reported a total of 57 exceedances.

The Michigan Beach Web site (<http://www.deq.state.mi.us/beach>) provides access to a database containing beach closings and *E. coli* data collected by LHDs. Currently, 564 public beaches located on inland lakes are listed in the database; although, not all beaches are monitored.

6.4 Designated Use Support Summary

A designated use support summary for Michigan inland lakes and reservoirs is presented in Table 6.2. Michigan uses a multiple category system (i.e., assessment units may be placed in one or more category, see Section 4.11); therefore, inland lake and reservoir acres and shoreline miles are not totaled. Key designated use support results follow. Impairment cause and source information for assessment units not supporting designated uses is presented in Chapter 9.

- Physical and chemical monitoring indicates that approximately 98% of the assessed inland lake and reservoir acres support the other indigenous aquatic life and wildlife designated use. Several water bodies are not supporting this designated use due to nuisance plant/algae growth problems caused by elevated phosphorus concentrations in the water column and/or sediments. Torch Lake (Houghton County) and Crooked Lake (Missaukee County) are not supporting this designated use and are listed in Category 4b due to historical copper stamp sand contamination and sediment problems from a historic wood chemical factory, respectively.
- Water chemistry and fish tissue monitoring indicates that about 10% of the assessed inland lake and reservoir acres support the fish consumption designated use. Ninety percent of the assessed acres do not support the fish consumption designated use because atmospheric deposition continues to be a major source of PCBs and mercury to Michigan's inland lakes and reservoirs; however, localized sources are still contributing to mercury and PCB fish contamination problems in some inland lakes and impoundments.
- Cisco population monitoring indicates that approximately 59% of the inland lakes designated and assessed for the coldwater fishery designated use, support the use, while the remaining 41% have insufficient information to make a designated use support determination.
- Generally, the total body contact and partial body contact recreation designated use is reported as shoreline miles for beaches. Monitoring for *E. coli* found that approximately 95% and 87% of the assessed inland lake and reservoir shoreline miles support the partial body contact and total body contact designated uses, respectively.

Table 6.2 Designated use support summary for inland lakes and reservoirs (approximately 872,109 acres). No inland lakes or reservoirs are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture (acres)	872,109	0	0	0	0	0	0
Navigation (acres)	871,277	832	0	0	0	0	0
Industrial Water Supply (acres)	872,109	0	0	0	0	0	0
Warmwater Fishery (acres)	1,082	752	869,981	295	0	0	0
Coldwater Fishery (acres)	131,965	92,677	647,467	0	0	0	0
Other Indigenous Aquatic Life and Wildlife (acres)	483,011	14,662	363,059	6,658	3,139	0	1,579
Partial Body Contact Recreation (acres/shoreline mi) *†	110 / 68.8	126 / 16.8	869,983 / 0.8	850 / 1.2	0 / 0	0 / 0	1041 / 1.8
Total Body Contact Recreation (acres/shoreline mi) *†	346 / 34.4	126 / 50	869,637 / 0.2	960 / 1.2	0 / 0	0 / 0	1041 / 3.6
Fish Consumption (acres)	35,561	17,172	504,550	554	173	0	314,186
Public Water Supply (acres) ‡	203	129	81	0	0	0	0

* Geographic extent may be reported in two different measurement units for this designated use (acres/shoreline mi). These values represent different assessment units (i.e., shoreline miles do not correspond to the acres listed).

† These designated uses apply to all surface waters of the state; however, some of these values represent shoreline miles. In most cases shoreline miles are bathing beaches. Shoreline records are created and entered into the ADB on a case-by-case basis where information is available. Records have not been established for all shoreline miles. The total number of inland lake and reservoir shoreline miles in the ADB is 89.4 miles. A small number of records exist for shoreline miles that have no data available and therefore are not assessed; however, this is not a comprehensive value for all not assessed inland lake and reservoir shoreline miles. The total number of inland lake and reservoir shoreline miles is not known.

‡ Approximately 414 acres of inland lakes and reservoirs are protected for the public water supply designated use.

CHAPTER 7

ASSESSMENT RESULTS: RIVERS

7.1 Biological Integrity

All available biological assessments (e.g., fish and macroinvertebrate communities, targeted and probabilistic study designs) are evaluated using the assessment methodology (Chapter 4) and potentially used to determine designated use support. As part of the MDEQ's water quality monitoring program, sites are selected using both targeted and



probabilistic study designs to assess the biological integrity of rivers and streams using macroinvertebrate communities. The MDEQ's Macroinvertebrate Community Status and Trend Monitoring Procedure (MDEQ, in preparation) is used to estimate the number of river miles supporting the other indigenous aquatic life and wildlife designated use. Results are available for watersheds monitored in 2008 through 2012 (draft data) (Figure 3.1 and Table 7.1). Results from the 2008 through 2012 cycle were combined to determine a statewide designated use support status estimate of 95% for the other indigenous aquatic life and wildlife designated use in Michigan rivers and streams. Results from this project will also be used to assess temporal trends in biological integrity.

Table 7.1 Proportion of river miles (draft data) supporting the other indigenous aquatic life and wildlife designated use based on macroinvertebrate community assessment results for watersheds monitored in 2008 through 2012 using the MDEQ's Macroinvertebrate Community Status and Trend Monitoring Procedure. Proportion of river miles is shown with 95% confidence interval range.

Watershed/watershed group	Year monitored	Number of survey stations	River miles (%) supporting the other indigenous aquatic life and wildlife designated use	95% Confidence Interval Range (%)
Western Upper Peninsula	2008	24	100	88 - 100
Northwest Michigan	2008	34	94	85 - 100
Rogue/Flat	2008	33	100	90 - 100
Thornapple River/Rabbit	2008	44	93	85 - 100
Pigeon – Cherry	2008	27	73	41 - 100
Flint River	2008	46	92	84 - 100
Lake St. Clair Tribs	2008	4	75	0 - 100
River Raisin	2008	36	100	92 - 100
Clinton	2009	33	94	86 - 100
Saginaw	2009	3	100	37 - 100
Rifle	2009	28	100	90 - 100
Kalamazoo	2009	40	100	93 - 100
Lower Grand	2009	44	84	74 - 94
Manistee/Big Sable	2009	34	100	92 - 100
Eastern Upper Peninsula -	2009	26	96	88 - 100

Watershed/watershed group	Year monitored	Number of survey stations	River miles (%) supporting the other indigenous aquatic life and wildlife designated use	95% Confidence Interval Range (%)
East				
Eastern Upper Peninsula - West	2009	26	100	89 - 100
Maumee Tribs	2010	35	94	86 - 100
Rouge	2010	48	79	68 - 90
Shiawassee	2010	49	84	73 - 95
Kawkawlin/Wiscoggin	2010	2	100	22 - 100
Thunder Bay/Cheboygan/Black	2010	31	100	91 - 100
Pere Marquette/Pentwater	2010	28	100	90 - 100
Macatawa	2010	12	100	78 - 100
Upper St. Joseph	2010	31	96	84 - 100
Central Upper Peninsula	2010	29	100	90 - 100
Au Gres/Tawas	2011	17	100	84 - 100
Cass	2011	23	96	87 - 100
Detroit/Ecorse	2011	5	40	0-100
Keweenaw	2011	14	100	81 - 100
Muskegon	2011	15	93	79 - 100
Upper Grand	2011	22	86	71 - 100
Lower St. Joseph	2011	27	100	89 - 100
Maple/Looking Glass	2012	15	100	82 - 100
Au Sable	2012	14	100	81 - 100
Black (Alcona Co.)	2012	4	100	47 - 100
St. Clair	2012	22	86	71 - 100
Galien/Black	2012	11	100	76 - 100
White	2012	13	100	79 - 100
Menominee	2012	15	100	82 - 100
Tittabawassee	2012	14	93	78 - 100
Huron	2012	32	84	71 - 97

7.2 Water Chemistry

The MDEQ and its partners collect water samples from many rivers and streams throughout the state as part of the WCMP and other special studies and analyze them for a variety of parameters. Results from monitoring conducted from 1998 through 2008 are summarized below. Quality assured data through 2011 were used for assessment updates for this reporting cycle. However, only data through 2008 was available for discussions of broader trends and results around Michigan as analyzed in the most recent WCMP report. Tributary monitoring efforts continue and results through 2008 are summarized with connecting channels (see Section 5.2) and bays (see Section 5.3) in greater detail in a report released in 2013 (MDEQ (MDEQ, 2013b).

Key results from monitoring through 2008 include the following:

- PCB analysis was conducted from 1998 to 2007, and then discontinued. The goal of this sampling was to determine if PCBs were ubiquitous in Michigan. While concentrations varied widely, PCBs were present in all samples and only met the WQS

of 0.026 ng/L (HCV per R 323.1057) on one occasion at the Cheboygan River site, although total PCB concentrations exceeded this standard at this station on other dates. Because the industrial use of PCBs has been banned, the primary sources of PCBs to water are likely historical sediment contamination and ongoing atmospheric deposition.

- Elevated levels of mercury were relatively common in water samples analyzed between 2010 and 2011. Of the 161 sites monitored during this period, 80 (50%) had geometric mean mercury concentrations exceeding the most restrictive mercury WQS of 1.3 ng/L (Wildlife Value per R 323.1057). Geometric mean mercury concentrations were highest at Dead Creek, Schoolcraft County (9.51 ng/L), and lowest at the Cedar Creek, Newaygo County (0.20 ng/L). Atmospheric deposition is the primary source of elevated mercury levels.
- Nearly all trace metal samples (other than mercury) that had sufficient information to make a determination met applicable WQS between 2010 and 2011. The exception, West Branch Duck Creek in Ontonagon County, had 2 exceedances of acute copper WQS (an Aquatic Maximum Value of 3.4 ug/L at a hardness of 23 mg/L CaCO₃) during the two-year period.
- Median total phosphorus concentrations statewide ranged from 0.168 mg/L at the Clinton River to 0.009 mg/L at the Cheboygan River tributary stations. The highest median concentrations were typically in the Huron-Erie Lake Plains and Southern Michigan/Northern Indiana Till Plains ecoregions. Orthophosphorus concentrations followed the same pattern.

7.3 Fish Contaminants

In 1990, Michigan initiated a fixed station fish contaminant trend monitoring project to measure spatial and temporal trends of certain bioaccumulative contaminants. Adult fish are collected from each site at a target interval of two to five years, and analyzed as whole fish samples. Carp were collected periodically from five river impoundment trend monitoring sites since 1990. These sites were located on the Muskegon, Grand, Kalamazoo, St. Joseph, and Raisin Rivers. Whole fish fixed station trend monitoring data collected between 1990 and 2011 were reviewed and general trend conclusions for rivers are summarized below:

- Lindane, terphenyl, PBB, heptachlor, and aldrin were not quantified in any of the fish sampled. However, heptachlor epoxide and dieldrin (breakdown products of heptachlor and aldrin) were quantified in most of the samples analyzed.
- In addition to heptachlor epoxide and dieldrin, several chemicals were quantified in fish consistently, indicating that they are ubiquitous in the aquatic environment. These include mercury, hexachlorobenzene, total PCBs, total chlordane, and total DDT.
- Average total PCB concentrations were highest in carp from the Kalamazoo River site. The Kalamazoo River has extensive areas of PCB contaminated sediments, a problem that is being addressed under state and federal programs.
- Total PCB concentrations declined at all 5 river trend sites, with an average decline of 7% per year since 1990.

- Total DDT concentrations declined at all river trend sites, with an average decline of 7% per year since 1990.
- Total chlordane concentrations declined at all 5 river trend sites, with an average decline of 8% per year since 1990.
- Mercury concentrations decreased 3% per year in fish from the River Raisin and 1% per year in fish from the Kalamazoo River. No significant trends in mercury concentration were measured in the Grand, Muskegon, or St. Joseph Rivers.

Edible portion fish tissue contaminant monitoring was conducted recently in 4 rivers: the Au Sable River downstream of the first dam (Foote Dam), Carp Creek and Carp River in Marquette County, and the Pine River in Gratiot County. Edible portion sampling is often targeted toward known sites of contamination, sites popular with sport anglers, and sites with public access. Results of the edible portion monitoring are used by the MDEQ in determining the status of the Fish Consumption designated use for a given water body and by the MDCH to update the fish consumption advisories. Of the 4 locations monitored in 2010 and 2011, 3 were assessed as not supporting the Fish Consumption designated use, while 1 was found to be fully supporting the same use.

7.4 Micro-organisms

In 2011, a total of 15 public beaches on rivers were monitored and 4 reported no exceedances of the *E. coli* WQS for total body contact. There were 11 beaches that reported a total of 15 exceedances.

In 2012, a total of 15 public beaches on rivers were monitored and 8 reported no exceedances of the *E. coli* WQS for total body contact. There were 7 beaches that reported 13 exceedances.

The Michigan Beach Web site (<http://www.deq.state.mi.us/beach>) provides access to a database containing beach closings and *E. coli* data collected by LHDs. Currently, 40 public beaches located on rivers are listed in the database.

Data collected through the WCMP program, while not of sufficient quality for assessments, may be used to estimate designated use attainment in monitored waters. In 2012 an estimated 60% of monitored rivers and streams met the total body contact designated use using WCMP data.

7.5 Designated Use Support Summary

A designated use support summary for Michigan rivers and streams is presented in Table 7.2. Michigan uses a multiple category system (i.e., assessment units may be placed in one or more category, see Section 4.11); therefore, river miles are not totaled. Key designated use support results follow. Impairment cause and source information for assessment units not supporting designated uses is presented in Chapter 9.

- Approximately 95% of the 55,222 assessed river miles are determined to not support the fish consumption designated use (Figure 7.1). Mercury in fish tissue, mercury in water column, PCB in fish tissue, and PCB in water column are the primary causes for river miles to not support the fish consumption designated use (Figures 7.2 through 7.5). Atmospheric deposition is considered to be the primary source of these persistent bioaccumulative chemicals. Water column PCB monitoring using highly sophisticated and sensitive sampling/analytical techniques indicates that 100% of the assessed river

miles are not attaining PCB WQS; therefore, a significant number of river miles are listed as not supporting the fish consumption designated use. A statewide TMDL for PCB was submitted for the USEPA's approval in 2013 addressing this wide-spread issue. A statewide TMDL for mercury is under development.

Sampling locations that do not overlay river miles that are not supporting the fish consumption designated use may have insufficient information to determine use support or may indicate designated use support. Please note that a color copy of Figure 7.1 is required to view all information. This IR is available in color at <http://www.michigan.gov/deqwater> under Water Quality Monitoring, Assessment of Michigan Waters.

- A majority of the river miles support the other indigenous aquatic life and wildlife designated use (Figure 7.6). The primary causes for river miles to not support the other indigenous aquatic life and wildlife designated use are PCB in water column, mercury in water column, and habitat alterations (Figures 7.7 through 7.9). PCB and mercury in the water column have been sampled at many locations statewide (Figures 7.8 and 7.9).

Sampling locations that do not overlay river miles that are not supporting the other indigenous aquatic life and wildlife designated use may have insufficient information to determine use support or may indicate designated use support. Please note that a color copy of Figure 7.6 is required to view all information. This IR is available in color at <http://www.michigan.gov/deqwater> under Water Quality Monitoring, Assessment of Michigan Waters.

- The majority of the river miles that are not supporting one or more designated uses indicated by poor biological communities have been highly modified by channel maintenance activities carried out primarily by Michigan's county drain commissions. These channel maintenance activities (including channel straightening, dredging, riparian vegetation removal, and snag removal) may result in poor biological communities caused by nonpollutants (habitat and/or flow alterations); therefore, these river miles are placed in Category 4c. The number of Category 4c river miles for the other indigenous aquatic life and wildlife designated use decreased from 6,738 miles in the 2008 IR. This change in Category 4c mileage is mainly due to availability of new biological data for many water bodies with channel maintenance activities including that collected in 2008 for Saginaw Bay and Lake Huron coastal tributaries (i.e., Pigeon and Cherry Rivers in Huron County) and reevaluation of designated use support using 2004 assessment methodology changes.
- Of the approximately 7,733 river miles assessed for the total body contact recreation designated use, about 1.4% were determined to support this designated use. Approximately 56% of the assessed river miles have TMDLs completed.
- Water column PCB monitoring using highly sophisticated and sensitive sampling/analytical techniques indicates that 100% of the assessed river miles are not attaining PCB WQS; therefore, a significant number of river miles are listed as not supporting the fish consumption designated use and/or the other indigenous aquatic life and wildlife designated use. Atmospheric deposition is considered to be the major source of this persistent bioaccumulative chemical.
- A 17.1-mile reach of the River Raisin (Lenawee County) is not supporting the public water supply designated use because nitrate-nitrogen concentrations in the source water

are above the USEPA's maximum contaminant level (10 mg/L) for nitrates. A USEPA-approved TMDL is in place to remediate this problem. This listing for River Raisin does not strictly follow the assessment methodology (i.e., the listing encompasses an area much larger than the 12-digit HUC; see Section 4.10) since the listing was created prior to the 2008 assessment methodology update and was meant to encompass a stretch of the river between two distinct drinking water intakes.

- A variety of TMDLs were completed and approved by the USEPA in 2012 resulting in newly listed river miles in Category 4a. In 2012 *E. coli* TMDLs were approved for Sault Ste. Marie area tributaries (Chippewa County), portions of the Red Cedar River and Grand River watersheds (Ingham, Eaton, Clinton, Jackson, and Livingston Counties), Little Portage Creek (Kalamazoo, St. Joseph, and Calhoun Counties), and Deer, Little Deer, and Beaver Creeks (Ottawa and Muskegon Counties). A statewide TMDL for PCB was submitted to the USEPA in 2013.

Table 7.2 Designated use support summary for rivers in Michigan (approximately 76,425 total miles). No rivers are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture (mi)	76,425	0	0	0	0	0	0
Navigation (mi)	76,425	0	0	0	0	0	0.06
Industrial Water Supply (mi)	76,425	0	0	0	0	0	0
Warmwater Fishery (mi)	9,082	1,025	64,065	1,604	3.2	328	1,059
Coldwater Fishery (mi)	5,729	1,030	69,362	138	3.5	81	78
Other Indigenous Aquatic Life and Wildlife (mi)	48,231	2,465	13,619	1,884	206	2,315	9,117
Partial Body Contact Recreation (mi)	1,518	7,961	61,183	3,908	2.5	0	1,852
Total Body Contact Recreation (mi)	111	7,932	61,150	4,301	2.5	0	2,929
Fish Consumption (mi)	2,519	82	21,927	786	1,867	0	50,109
Public Water Supply (mi) *	99	0.1	475	17	0	0	0

* Approximately 592 of the 76,433 river miles are protected for the public water supply designated use.

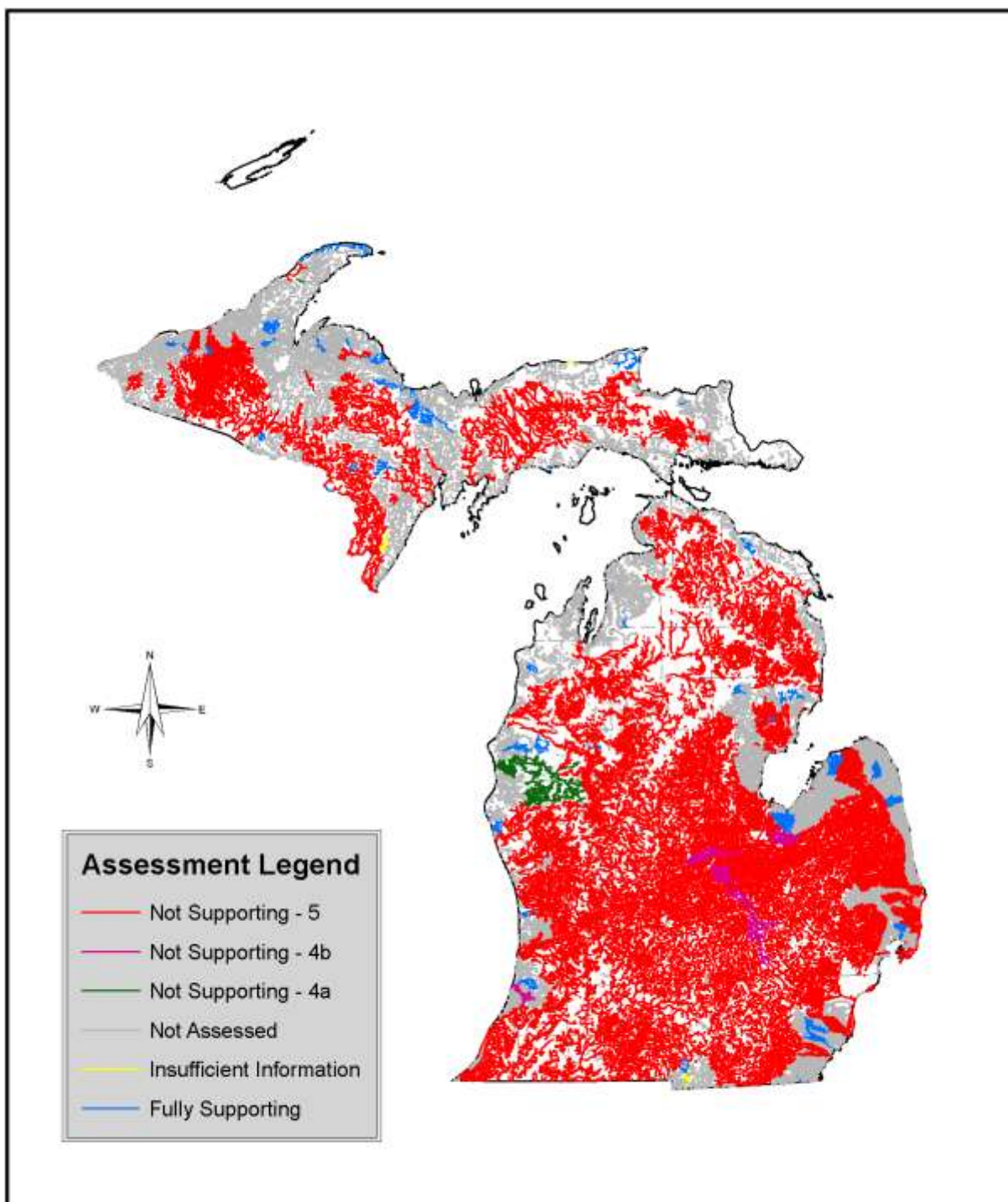


Figure 7.1 Fish consumption designated use support for Michigan rivers.

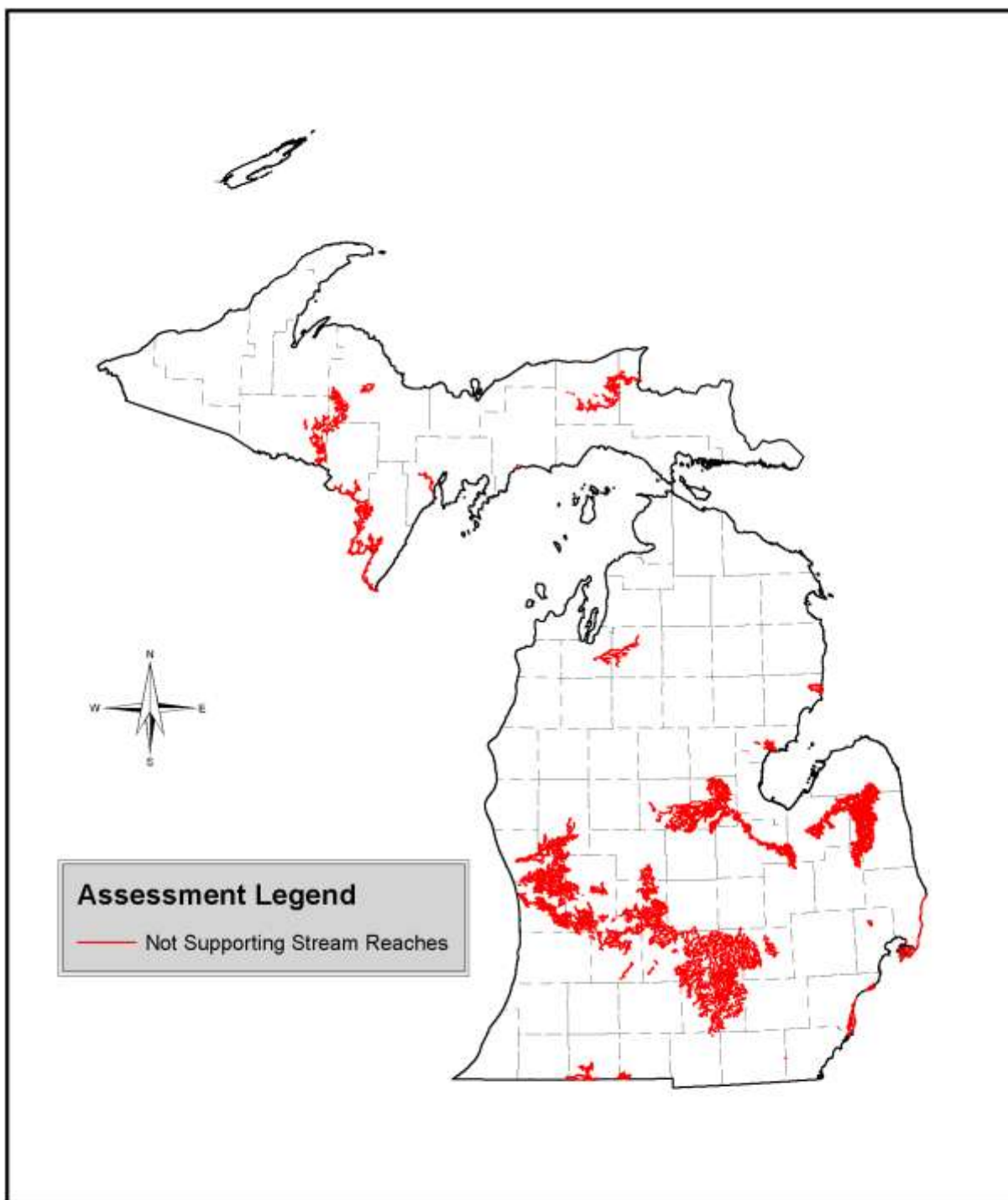


Figure 7.2 Rivers not supporting the fish consumption designated use based on mercury in fish tissue (Category 5.)

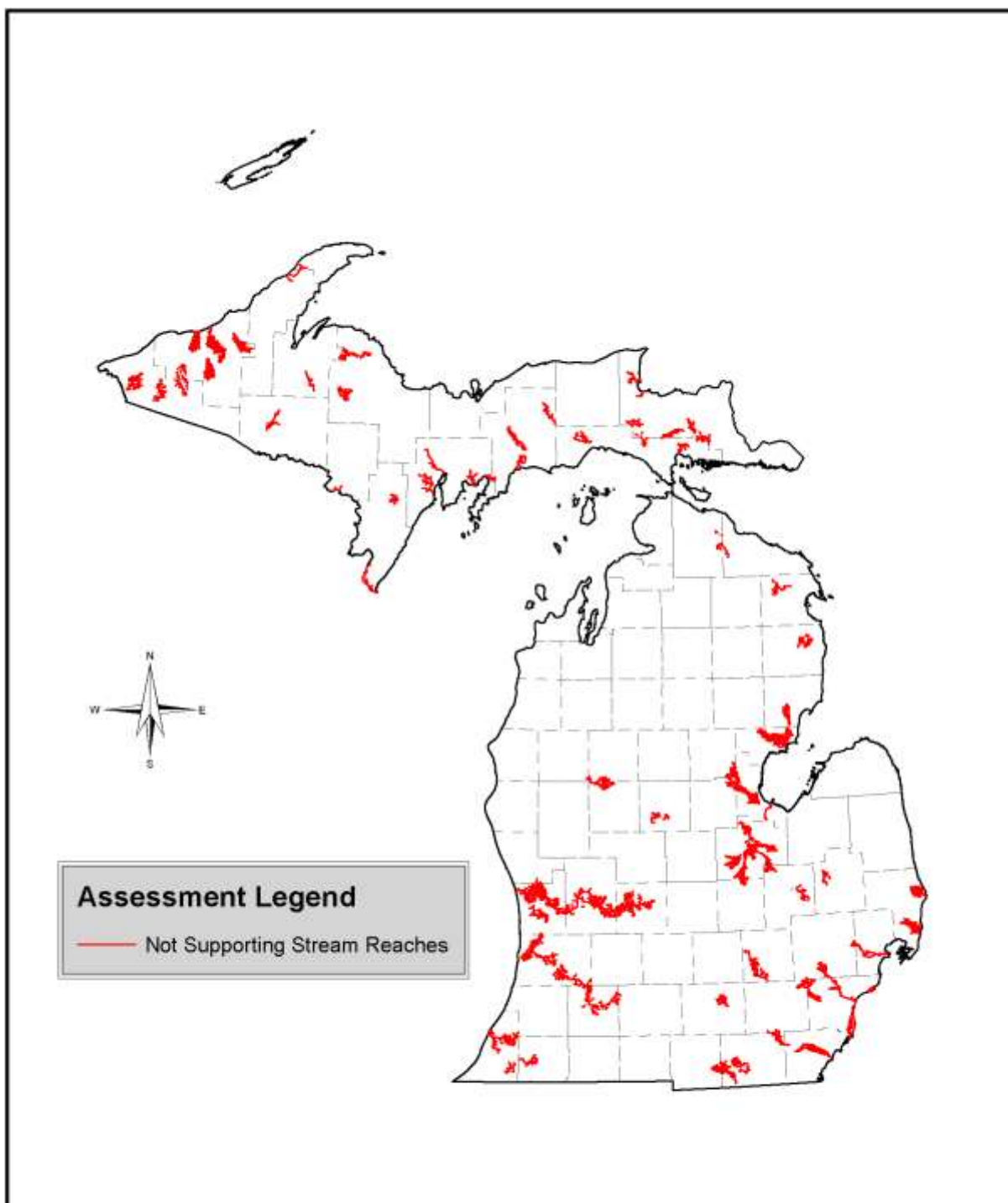


Figure 7.3 Rivers not supporting the fish consumption designated use based on mercury in water column (Category 5.)

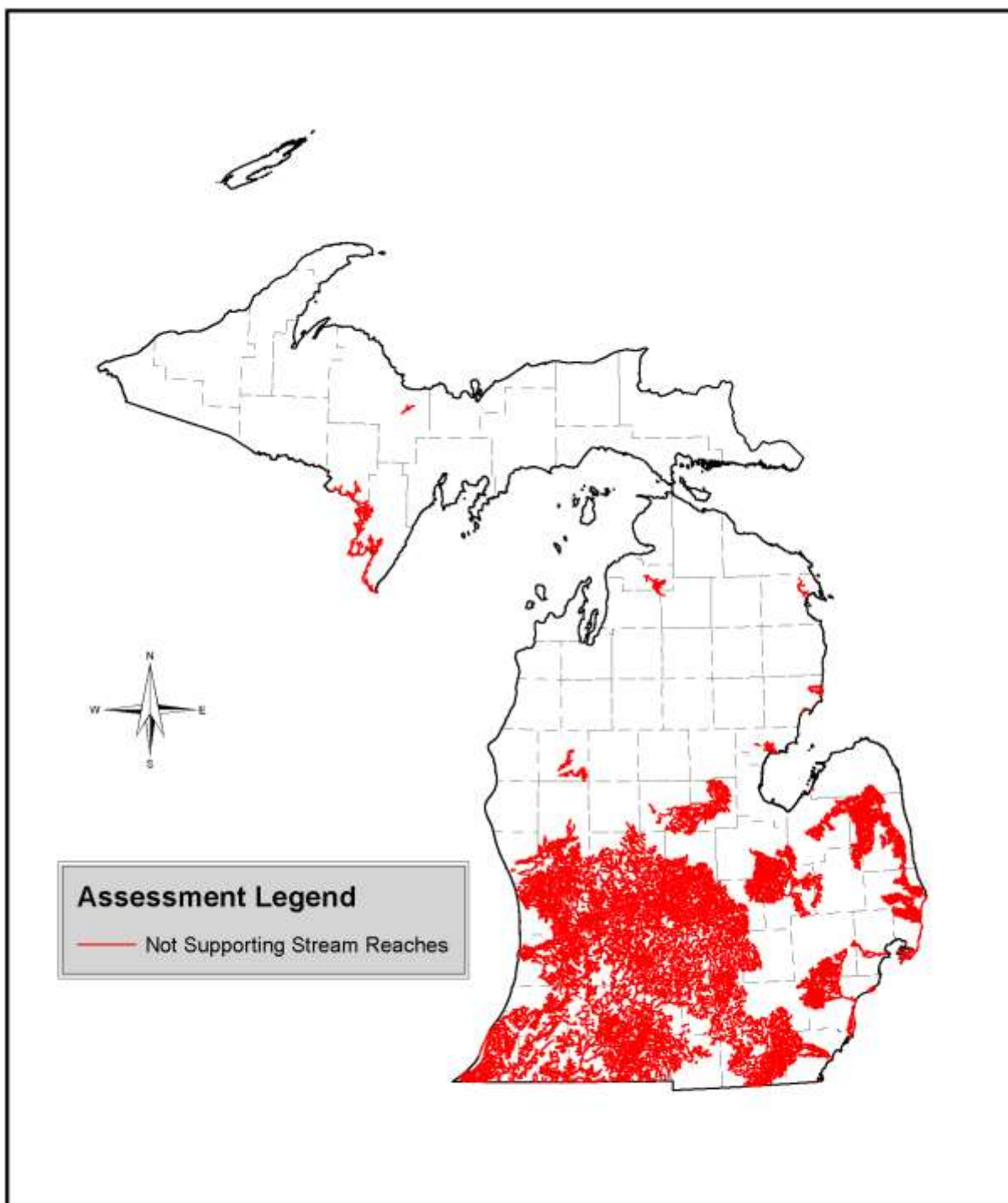


Figure 7.4 Rivers not supporting the fish consumption designated use based on PCB in fish tissue (Category 5.)

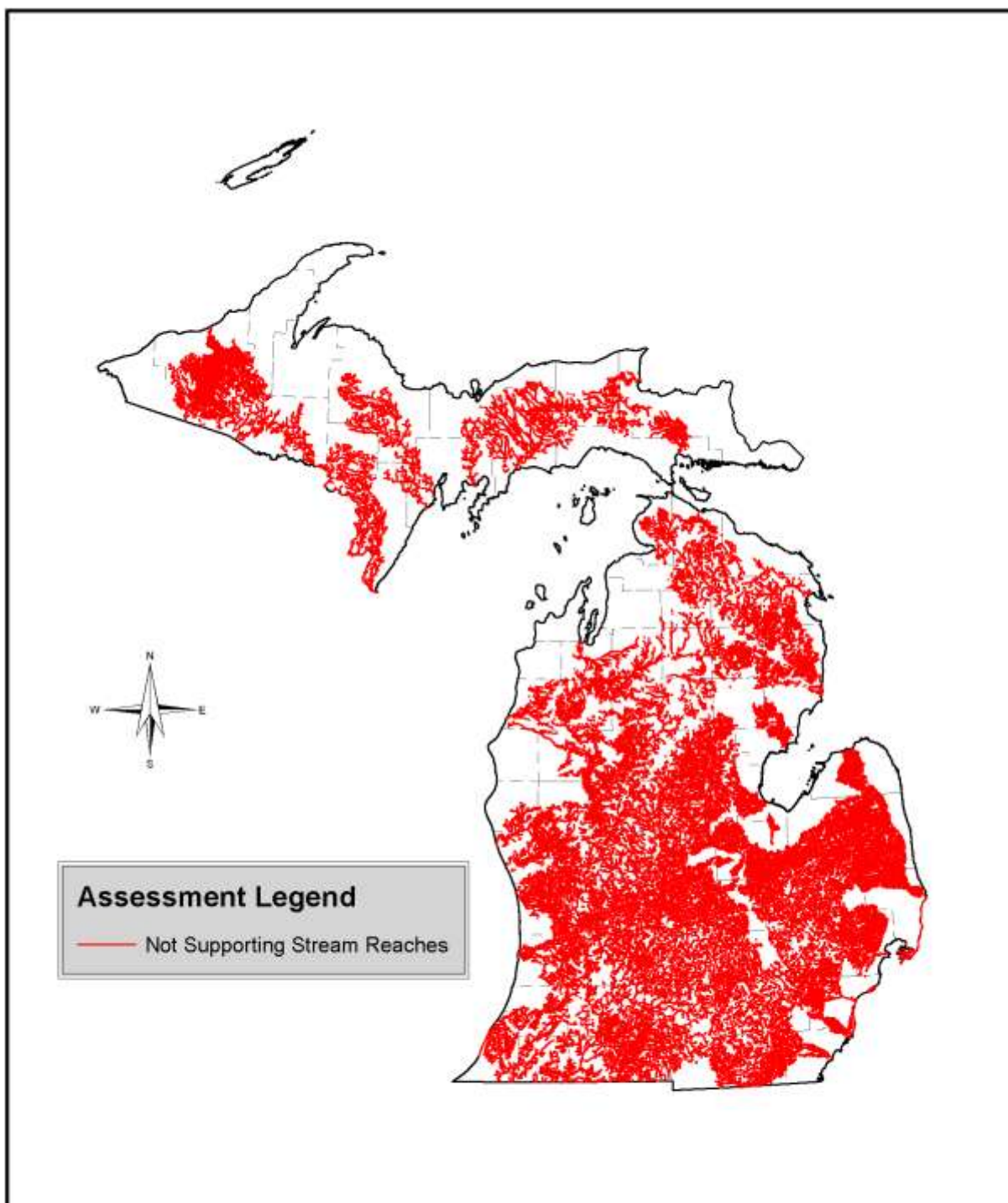


Figure 7.5 Rivers not supporting the fish consumption designated use based on PCB in water column (Category 5.)

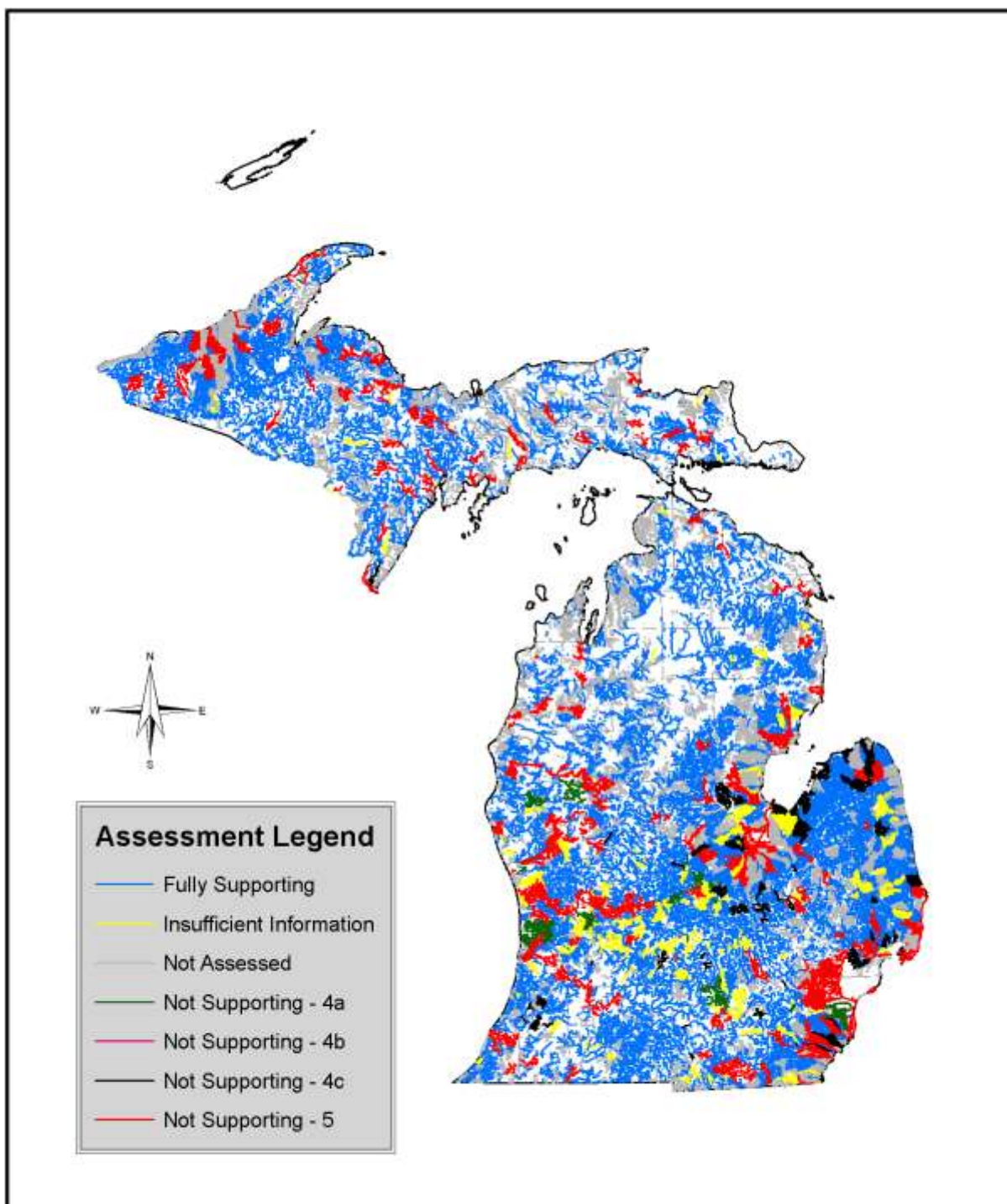


Figure 7.6 Other indigenous aquatic life and wildlife designated use support summary for Michigan rivers.

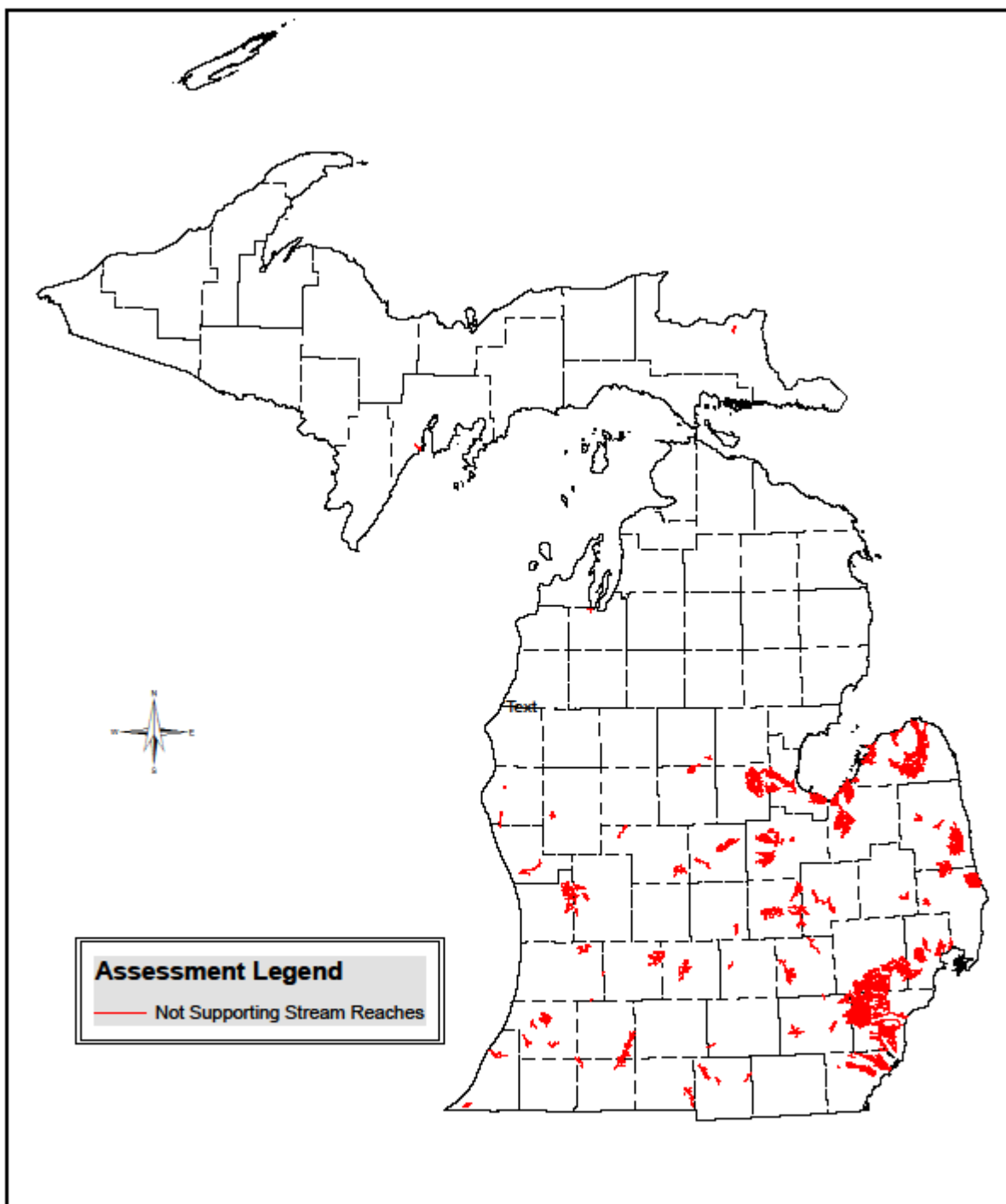


Figure 7.7 Rivers not supporting the other indigenous aquatic life and wildlife designated use based on habitat alterations.

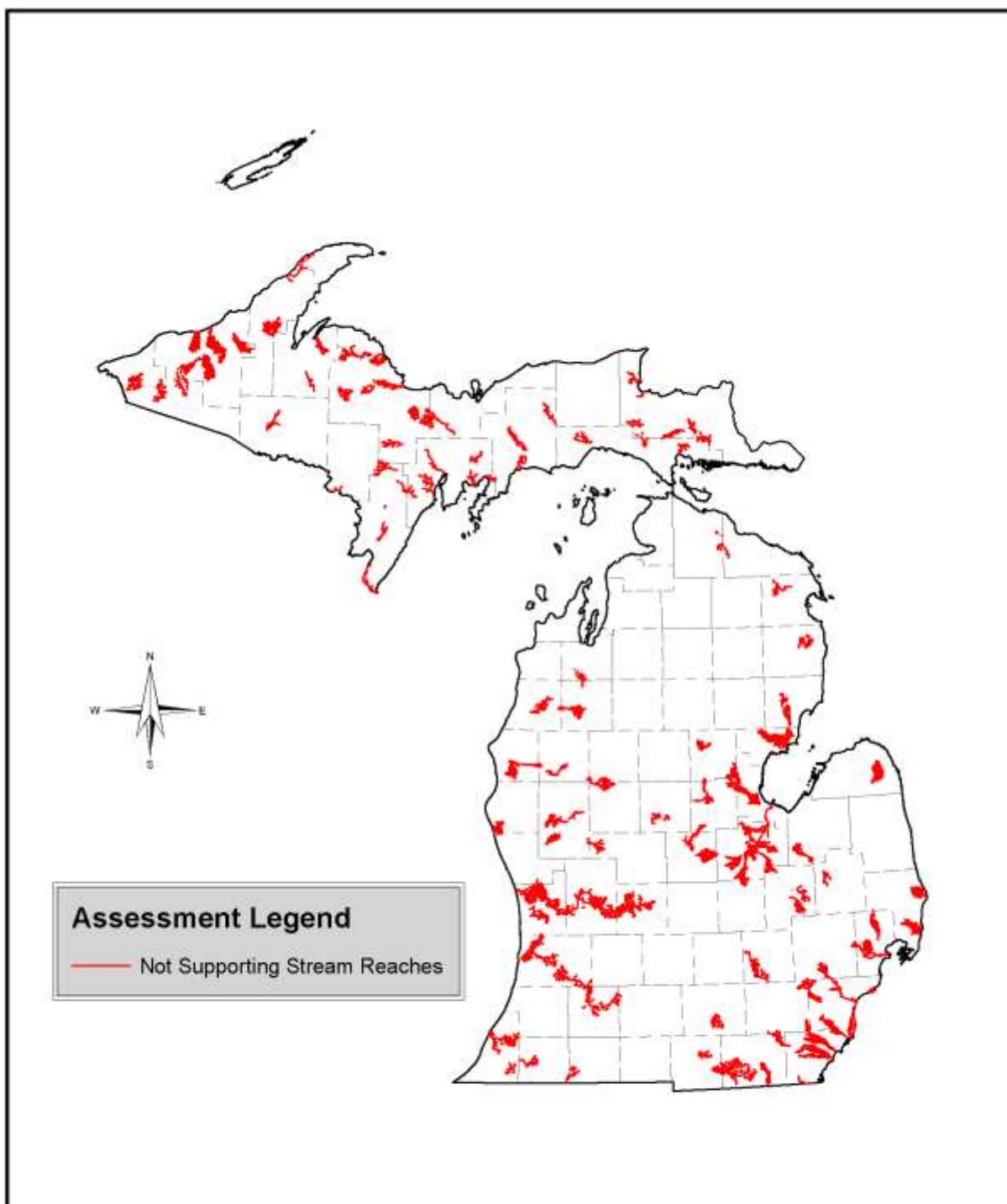


Figure 7.8 Rivers not supporting the other indigenous aquatic life designated use based on mercury in water column.

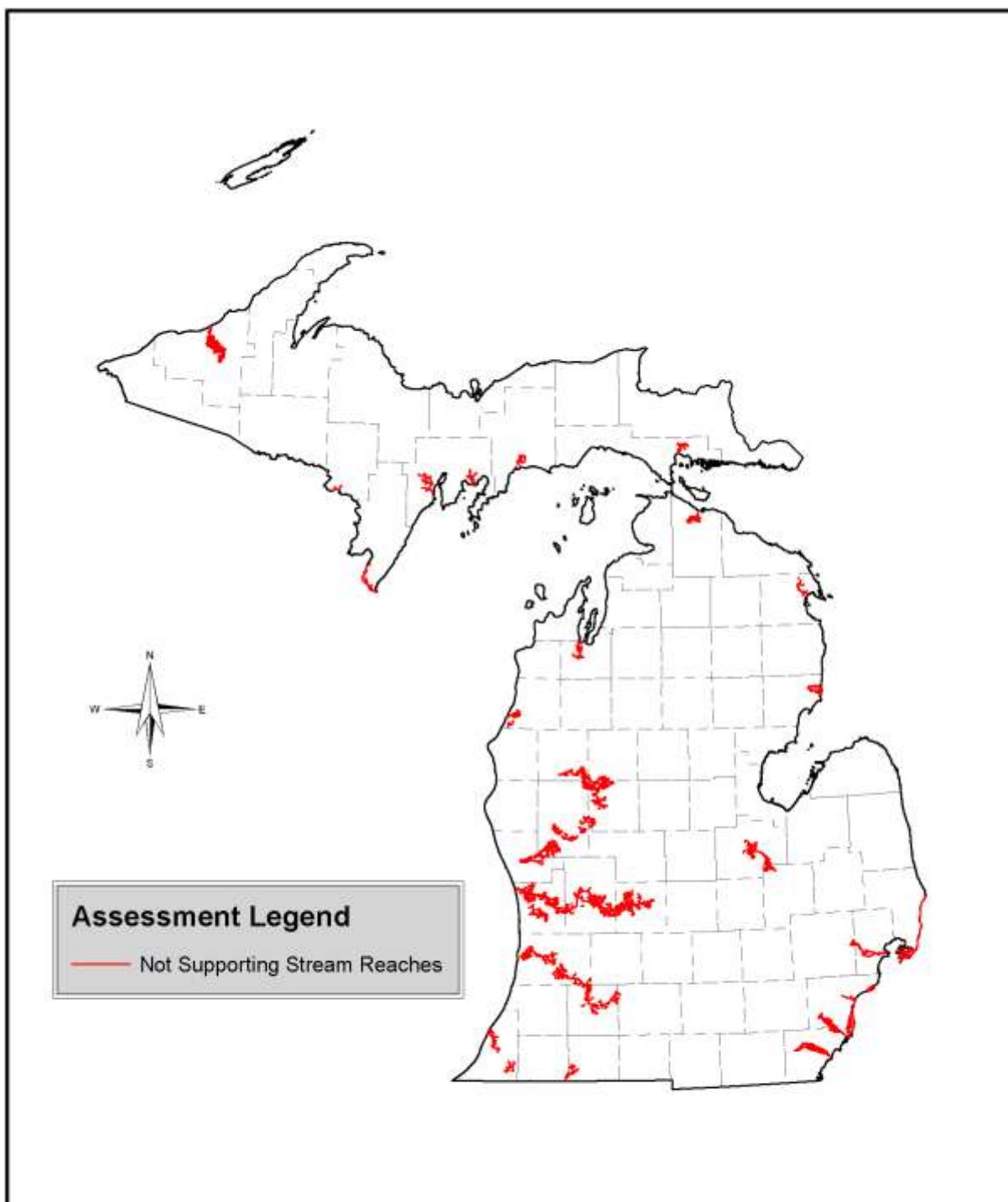


Figure 7.9 Rivers not supporting the other indigenous aquatic life designated use based on PCB in water column.

CHAPTER 8 ASSESSMENT RESULTS: WETLANDS

8.1 Designated Use Support Summary

Michigan's WQS apply to all surface waters of the state, including wetlands. However, some criteria may not be applicable to wetlands. For example, a highly productive wetland with abundant vegetation in shallow water and high organic content in the sediment may naturally exhibit low dissolved



oxygen levels in the water column. Based on Rule 100(10) of the WQS, use attainability studies are allowed for certain wetlands to address this situation.

Michigan's wetlands are currently assessed for designated use support on an as needed basis. The known designated use support information is listed in Table 8.1. Michigan uses a multiple category system (i.e., assessment units may be placed in one or more category, see Section 4.11); therefore, wetland acres are not totaled. Details regarding the four listed wetlands follow. Impairment cause and source information for assessment units not supporting designated uses is presented in Chapter 9.

- A 10-acre wetland in the Escanaba River watershed (Marquette County) previously listed as not supporting designated uses was remediated in 1997. The other indigenous aquatic life and wildlife designated use of this wetland was restored by the reduction of nickel contamination from an upstream point source discharge.
- A small wetland area in the Grand River watershed (0.25 acres in Jackson County) is listed as having insufficient information to determine if the other indigenous aquatic life and wildlife designated use is supported due to point sources discharges and contaminated groundwater.
- Tobico Marsh (Bay County), a 680-acre marsh adjacent to Saginaw Bay, is not supporting the fish consumption designated use due to elevated PCB concentrations in carp and northern pike populations. Carp, largemouth bass, and northern pike were collected and analyzed in 2007. These new data did not result in a change to the fish consumption advisory.
- Ruddiman Creek Lagoon (21 acres in Muskegon County) is not supporting the fish consumption, and total and partial body contact recreation designated uses. This wetland is the subject of a major sediment remediation project that involves the removal of approximately 80,000 cubic yards of sediments contaminated with PCBs, metals, and polynuclear aromatic hydrocarbons.

Table 8.1 Designated use support summary for Michigan wetlands (approximately 6,432,461 total acres). All wetland acres are not entered in the ADB. Wetlands that have specific information are entered into the ADB on a case-by-case basis. No wetlands are listed in Category 1 since comprehensive water quality data and/or information are not available for any locations. N/A indicates that the designated use is not applicable.

Designated Use	Supporting	Insufficient Information	Not Assessed	Not Supporting			
	Category 2	Category 3	Category 3	Category 4a	Category 4b	Category 4c	Category 5
Agriculture	6,432,461	0	0	0	0	0	0
Navigation	6,432,461	0	0	0	0	0	0
Industrial Water Supply	6,432,461	0	0	0	0	0	0
Warmwater Fishery	0	0	6,432,461	0	0	0	0
Coldwater Fishery	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Other Indigenous Aquatic Life and Wildlife	10	0.25	6,432,450.75	0	0	0	0
Partial Body Contact Recreation	0	0	6,432,440	21	0	0	0
Total Body Contact Recreation	0	0	6,432,440	21	0	0	0
Fish Consumption	0	0	6,431,760	0	0	0	701
Public Water Supply	N/A	N/A	N/A	N/A	N/A	N/A	N/A

CHAPTER 9 WATER BODIES NOT SUPPORTING DESIGNATED USES AND CWA SECTION 303(D) REQUIREMENTS

9.1 Introduction

The purpose of this chapter is to provide additional information regarding water bodies that are determined to not support one or more designated uses (i.e., water bodies that are listed in Categories 4 or 5; see Section 4.11 for a description of the categories). Section 303(d)

of the CWA and the USEPA's Water Quality Planning and Management Regulations (40 CFR, Part 130) require states to develop TMDLs for water bodies that are not meeting WQS (i.e., water bodies that are listed in Category 5). The TMDL process establishes the allowable loadings of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. TMDLs provide states a basis for determining the pollutant reductions necessary from both point sources and NPS to restore and maintain the quality of their water resources.



9.2 Impairment Cause and Source

When a determination is made that a designated use is not supported (includes both Categories 4 and 5), the cause and source (when known) of impairment is identified (see Section 4.12). Each assessment unit may be listed for one or more causes and sources of impairment. The following tables are sorted by cause or source with the greatest geographic extent listed first.

9.2.1 Great Lakes and Connecting Channels

All of Michigan's Great Lakes, bays, and Lake St. Clair are listed as not supporting one or more designated use with various causes and sources of impairment (statewide total approximately 42,167 mi² / 3,065 shoreline miles; Tables 9.1 and 9.2).

Table 9.1 Michigan Great Lakes and bays not supporting designated uses listed by cause of impairment.

Cause	Total mi ² / shoreline mi
Toxic organics	
PCBs in fish tissue	42,167 / 3,065
PCBs in water column	13.5 shoreline mi
Dioxin	41,937 / 2,963
Pesticides	
Chlordane	29,944 / 1,975
DDT	13,250 / 1,058
Metals	
Mercury in fish tissue	32,857 / 2,064
Nutrients	3 mi ²
Taste and odor	3 mi ²
Pathogens	6.6 shoreline mi

Table 9.2 Michigan Great Lakes and bays not supporting designated uses listed by source of impairment.

Source	Total mi ² / shoreline mi
Atmospheric deposition	42,167 / 3,065
Agriculture	4,373 / 529
Contaminated sediment	1,137 / 0
Industrial point source discharge	3 / 0.2
Municipal point source discharge	3 / 0.1
NPS	3 / 0.4
Collection system failures	3 shoreline mi
On-site treatment systems	0.2 shoreline mi
Illicit connections	0.6 shoreline mi
Waterfowl	0.4 shoreline mi
Source unknown	2.7 shoreline mi

All Great Lakes connecting channel miles are listed as not supporting one or more designated use with various causes and sources of impairment (statewide total approximately 125 miles; Tables 9.3 and 9.4).

Table 9.3 Michigan connecting channel river miles not supporting designated uses listed by cause of impairment.

Cause	Total miles
Toxic organics	
PCBs in water column	125
PCBs in fish tissue	125
Dioxin	26
Metals	
Mercury in fish tissue	125
Mercury in water column	26
Pathogens	49
Pesticides	
DDT	26

Table 9.4 Michigan connecting channel river miles not supporting designated uses listed by source of impairment.

Source	Total miles
Atmospheric deposition	125
CSOs	49
Illicit connections	33
Source unknown	24

9.2.2 Inland Lakes and Reservoirs

Many inland lakes and reservoirs that do not support one or more designated uses are impacted by atmospheric deposition of mercury and/or PCBs. Several other causes and sources of impairment are also identified (statewide total approximately 872,109 acres; Tables 9.5 and 9.6).

Table 9.5 Michigan inland lake and reservoir acres not supporting designated uses listed by cause of impairment.

Cause	Total acres
Metals	
Mercury in fish tissue	253,995
Copper	3,174
Zinc	480
Mercury in water column	367
Toxic organics	
PCBs in fish tissue	144,692
Dioxin	19,945
Polycyclic Aromatic Hydrocarbons	480
PCBs in water column	614
PBBs	86
Pesticides	
Chlordane	14,376
DDT	86
Nutrients	7,836
Pathogens	2,001 4.8 shoreline mi
Selenium	408
Excess algal growth	4284

Table 9.6 Michigan inland lake and reservoir acres not supporting designated uses listed by source of impairment.

Source	Total acres
Atmospheric deposition	314,733
Source unknown	16,991 4.2 shoreline mi
Contaminated sediment	8,700
Municipal point source discharges	4,919
Agriculture	6,698 0.6 shoreline mi
Mine tailings	3,067
Copper	35
Industrial point source discharges	1,375
CSOs	969
Internal nutrient recycling	408
Unspecified storm sewer	2,167
Sewerage discharge in unsewered areas	734
Construction- site clearance	2
Waterfowl	0.2 shoreline mi
Non-point source	5,643
Illicit Connection/Urban Runoff/Storm Sewers	817

9.2.3 Rivers

Many rivers that do not support one or more designated uses are impacted by atmospheric deposition of mercury and/or PCBs. Several other causes and sources of impairment are also identified (statewide total approximately 76,425 miles; Tables 9.7 and 9.8).

Table 9.7 Michigan river and stream miles not supporting designated uses listed by cause of impairment.

Cause	Total mi
Toxic organics	
PCBs in water column	49,711
PCBs in fish tissue	22,134
Dioxin	727
PBBs	189
PAHs	2
PCBs in sediment	5
Metals	
Mercury in fish tissue	6,682
Mercury in water column	7,515
Copper	67
Flow alterations	3,649
Pathogens	7,232
Habitat alterations	2,782
Bacterial slimes	25
Sedimentation/siltation	2,031
Oxygen depletion	1,473
Nutrients	657
Organic enrichment (sewage)	76
Pesticides	
DDT	189
Chlordane	285
Cause unknown	275
Excess algal growth	80
Thermal impacts	54
Aquatic plants	28
Selenium	21
Total suspended solids	27
Total dissolved solids	122
pH (caustic)	1

Table 9.8 Michigan river and stream miles not supporting designated uses listed by source of impairment.

Source	Total mi
Atmospheric deposition	52,526
Source unknown	7,658
Habitat alterations	4,067
Hydromodifications	3,281
Municipal permitted discharges	2,265
Storm water permitted discharges	2,496
Agriculture - grazing	2,107
Agriculture - crop production	2,090
Agriculture - animal feeding/handling	2,037
Spills and unpermitted discharges	1,635
Urban related runoff/storm water	2,029
Legacy/historical pollutants	807
Industrial permitted discharges	679
NPS	1,351
Land application/waste sites	569
Natural	197
Resource extraction	152
Groundwater loadings	26
Construction	22
Turf management	4

9.2.4 Wetlands

Two wetlands, Tobico Marsh (680 acres in Bay County) and Ruddiman Creek Lagoon (21 acres in Muskegon County), are not supporting the fish consumption designated use. PCBs are the cause of impairment with multiple sources listed (statewide total approximately 6,432,461 acres; Tables 9.9 and 9.10).

Table 9.9 Michigan wetland acres not supporting designated uses listed by cause of impairment.

Cause	Total acres
Toxic organics	
PCBs in fish tissue	701
PCBs in water column	21
Pathogens	21

Table 9.10 Michigan wetland acres not supporting designated uses listed by source of impairment.

Source	Total acres
Atmospheric deposition	701
Groundwater loadings	680
Land application/waste sites	680
Sewage discharge in unsewered area	21

9.3 TMDL Development

9.3.1 The TMDL Process

Michigan's Section 303(d) list consists of assessment units that are listed in Category 5. A TMDL is developed for each cause (see Section 9.2) or a TMDL may address more than one related cause. In addition to the information used to determine designated use support (see Section 4.2), several references are used to develop the Section 303(d) list: 40 CFR, Parts 122, 123, and 130; USEPA Guidance for Water Quality-Based Decisions: The TMDL Process, April 1991; and New Policies for Establishing and Implementing TMDLs (August 8, 1997, Robert Perciasepe memo to USEPA Regional Administrators).

Development of a TMDL is typically preceded by collection of water quality data by the MDEQ or its contractors to document current pollutant loads within the water body of concern and further define potential sources of the pollutant. These data, in addition to any other relevant information, form the basis for determining the necessary pollutant load reductions. A TMDL document is comprised of several sections including identification of the impaired assessment unit and cause of impairment, description of water quality studies conducted to identify the extent and source(s) of the impairment, and calculation of necessary load reductions for the point source and NPS to achieve WQS. The TMDL also identifies any past, current, or future known actions to remedy the impairment and a monitoring schedule to track improvements following implementation of the TMDL.

The TMDL document is typically developed by staff members of the MDEQ. The draft document is made available for public review on the MDEQ's Web site for at least 30 days. The announcement for the public comment period is published in the MDEQ calendar. During the public comment period, the MDEQ staff normally hold a public meeting in a community near the impaired water body to describe the TMDL and receive comments. Local stakeholders, including the general public, LHDs, local government, and county extension officials are sought to attend the meetings to contribute their expertise in identifying pollutant sources and discuss source reduction/elimination. Following the comment period, the TMDL is modified as appropriate to address comments received.

The TMDL is finalized following the public comment period and submitted to the USEPA, Region 5, for their review and approval. The USEPA has 30 days to review and approve or disapprove a TMDL. After a TMDL is approved by the USEPA, the water body is removed from the Section 303(d) list (Category 5) and reclassified as Category 4a. For additional information regarding delisting Category 5 assessment units see Section 4.13.

9.3.2 TMDLs Completed

In 2012 108 assessment units had TMDLs approved for *E. coli* (Table 9.11) addressing multiple sources. In addition a statewide TMDL for PCB, addressing 2,110 assessment units, was submitted to the USEPA in 2013. Additional information regarding approved TMDLs is available at <http://www.michigan.gov/deqwater> under Water Quality Monitoring, Assessment of Michigan Waters, TMDLs.

Table. 9.11 Number of assessment units with TMDLs approved in 2012.

Year	Parameter	Number
2012	Pathogen	108

9.3.3 TMDL Schedule

To facilitate organization and communication, TMDL groups were created for the 2014 IR. These TMDL groups do not relate to how the USEPA counts the number of TMDLs that are scheduled or completed. A TMDL group consists of assessment units in close geographic proximity listed in Category 5 with the same cause(s) and source(s).

TMDL groups are prioritized for TMDL development considering the existing TMDL schedule (i.e., the number of TMDLs currently scheduled for each year), Michigan's five-year rotating watershed cycle (Figure 3.1), available resources to complete TMDLs, data and supporting information quality and quantity, complexity of the problem and severity of the pollution, and the USEPA's recommendation to develop TMDLs within 13 years of listing.

TMDLs for organic chemicals with atmospheric sources (e.g., chlordane, DDT, and dioxin) will likely be addressed by a common approach; for example statewide TMDLs for waters impaired primarily by atmospheric sources of mercury and PCBs have been developed. Michigan's 303(d) list, including assessment unit information and TMDL year, is presented in Appendix C.

9.3.4 Changes to the Section 303(d) List

Modifications to the 2012 Section 303(d) list to create the 2014 Section 303(d) list are provided in Appendix D. This list reflects the deletion and addition of assessment units or causes of impairment since the 2012 IR. Section 303(d) delisted assessment units may or may not support designated uses. For example, it may have been determined that the assessment unit is not supporting one or more designated uses but a TMDL is not required, or a cause of impairment may have been removed but a TMDL is still required to address a different cause of impairment. A brief delisting reason is provided in Appendix D; detailed information may be found in the comment field in the ADB via the MiSWIMS (<http://www.michigan.gov/miswims>). Deletions and additions to the Section 303(d) list presented in Appendix D are also displayed on the following maps (Figures 9.1 and 9.2).

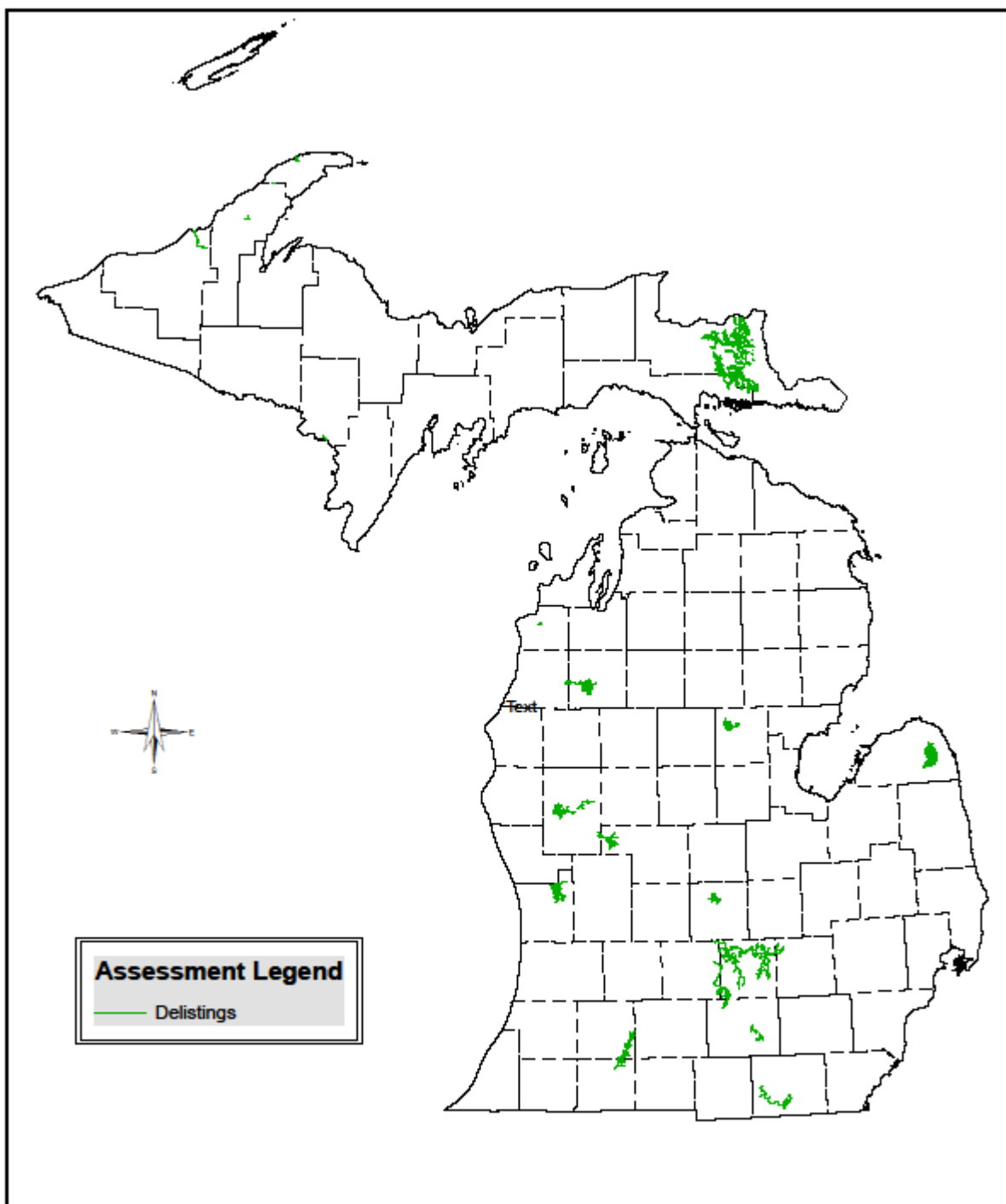


Figure 9.1 Section 303(d) Delistings. This information is displayed in table format in Appendix D1.

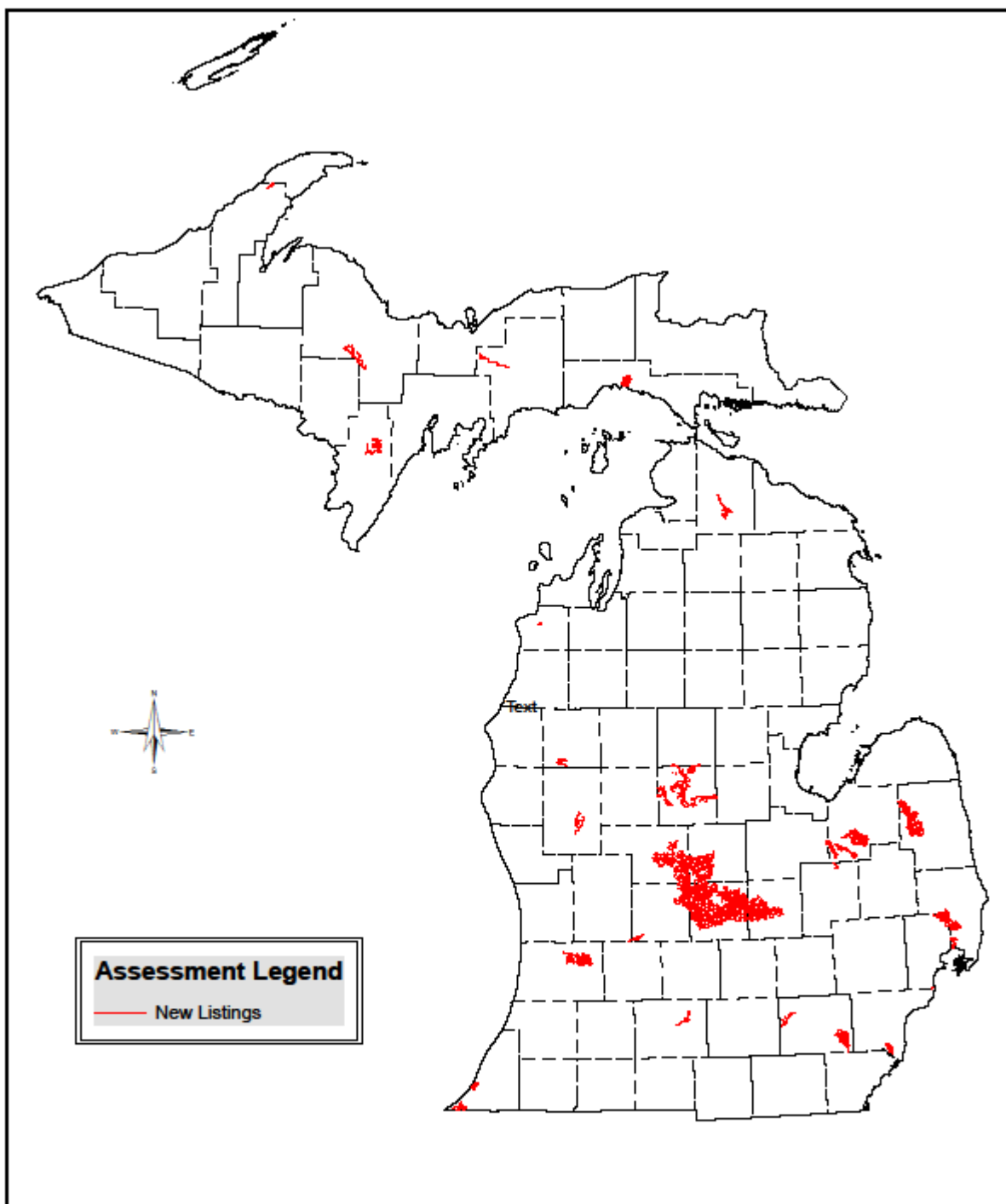


Figure 9.2 Section 303(d) New Listings. This information is displayed in table format in Appendix D2.

CHAPTER 10 PUBLIC PARTICIPATION IN THE IR

10.1 Introduction

The MDEQ provides opportunities for public participation in the development of the IR. The following information is a summary of those opportunities, the comments or information received from the public, and the MDEQ's response.

10.2 Request for Data

The MDEQ, WRD, requested ambient water quality data (chemical, biological, or physical) that was obtained by other governmental agencies, nongovernmental organizations, or the public for Michigan surface waters since January 1, 2011. All water quality data submitted to the MDEQ, WRD, before March 1, 2013 was evaluated according to the MDEQ's assessment methodology (see Chapter 4) and potentially used to help prepare this IR. This request was published on the MDEQ's calendar on January 14, January 28, February 11 and February 25, 2013, and e-mailed to key individuals in the MDNR's Fisheries Division, MDARD-Right to Farm, United States Forest Service, USFWS, University of Michigan, Alliance for the Great Lakes, and the USEPA. Data were received from the following organizations: USFWS, Little Traverse Bay Bands of Odawa Indians, United States National Parks Service, Alliance for the Great Lakes, and the United State Forest Service.



10.3 Public Notice of Draft Assessment Methodology

A draft version of Chapter 4, the assessment methodology, was made available on the MDEQ's Web site for public review and comment. This announcement was published on the MDEQ's calendar on February 11 and February 25, 2013. Public comments to be considered in the development of Chapter 4 were due March 11, 2013. No public comments on the draft assessment methodology were received.

10.4 Public Notice of the Draft IR

A draft version of this IR was made available on the MDEQ's Web site for public review and comment from December 2, 2013, through January 10, 2014. This announcement was published on the MDEQ's calendar on December 2, 16, and 30, 2013.

The MDEQ recognizes the importance of public comments and thanks individuals and organizations that provide input, express water quality concerns, or pose questions. The following section will summarize the MDEQ's response to public comments pertaining to the Draft 2014 IR. Public comments to the Draft Integrated Report will be presented in their entirety in Appendix E.

Literature Cited

- Bohr, J. and J. VanDusen. 2009. Michigan Fish Contaminant Monitoring Program: 2008 Annual Report. Michigan Department of Environmental Quality, Water Bureau. Report #MI/DEQ/WB-09/044.
- Canadian Aquatic Invasive Species Network. 2009. Website accessed February 9, 2009. <http://www.uwindsor.ca/CAISN>.
- Comer, P. 1996. Wetland Trends in Michigan Since 1800: a Preliminary Assessment. Report to USEPA and DEQ-LWMD. Submitted 1996. 76 pp.
- Creal, W., S. Hanshew, S. Kosek, M. Oemke, and M. Walterhouse. 1996. Update of GLEAS Procedure 51 Metric Scoring and Interpretation. DNRE Report #MI/DEQ/SWQ-96/068. Revised May 1998.
- Fuller, L.M. and C.K. Taricska. 2012. Water-Quality Characteristics of Michigan's Inland Lakes, 2001-10. U.S. Geological Survey Scientific Investigations Report 2011-5233, 53 pp.
- GLEC. 2006a. Great Lakes Connecting Channels Data Evaluation and Trend Analysis Report. Report #MI/DEQ/WB-06/092.
- GLEC. 2006b. Water Quality Monitoring of Saginaw and Grand Traverse Bays 2005 Annual Data Report. Report #MI/DEQ/WB-07/054.
- GLEC. 2007a. Great Lakes Connecting Channels 2005 Annual Data Report. Report #MI/DEQ/WB-07/066.
- GLEC. 2007b. Water Quality Monitoring of Saginaw and Grand Traverse Bays. 2005 Annual Data Report. Report #MI/DEQ/WB-07/054.
- Goodwin, K., S. Noffke, and J. Smith. 2012. Water Quality and Pollution Control in Michigan: 2012 Sections 303(d), 305(b), and 314 Integrated Report. MI/DEQ/WRD-12/001.
- Great Lakes Environmental Research Laboratory. 2009. Aquatic Invasive Species website accessed March 18, 2009. <http://www.glerl.noaa.gov/res/Programs/ais/>.
- Harris, V. 2004. *Cladophora* Confounds Coastal Communities – Public Perceptions and Management Dilemmas. Proceedings from the *Cladophora* Research and Management in the Great Lakes workshop, University of Wisconsin-Milwaukee. December 8, 2004.
- Hecky, R.E., R.E.H. Smith, D.R. Barton, S.J. Guildford, W.D. Taylor, M.N. Charlton, and T. Howell. 2004. The Nearshore Phosphorus Shunt: A Consequence of Ecosystem Engineering by Dreissenids in the Laurentian Great Lakes. Can. J. Fish. Aquat. Sci. 61(7):1285-1293.
- International Association for Great Lakes Research. 2002. Research and Management Priorities for Aquatic Invasive Species in the Great Lakes. 22 pp.
- Jones, R. and K. Gerard. 1999. Reference Site Sediment Chemistry Report for Wadable Streams, 1994, 1997 and 1998. March 1999. MDEQ Report No. MI/DEQ/SWQ-99/060.

- Lodge, D. and D. Finnoff. 2008. Invasive Species in the Great Lakes: Costing Us Our Future. Annual Losses to Great Lakes Region by Ship-Born Invasive Species at Least \$200 Million. Preliminary Research Results. Available at: <http://www.glu.org/fr/node/208>. Accessed December 29, 2011.
- Lovell, S. J., S.F. Stone, and L. Fernandez. 2005. The Economic Impacts of Aquatic Invasive Species: A Review of the Literature. *Agricultural and Resource Economics Review* 35(1): 195-208.
- MacDonald, D. C. Ingersoll and T. Berger. 2000. Development and Evaluation of Consensus Based Sediment Quality Guidelines for Freshwater Ecosystems. *Arch. Environ. Contam. Toxicol.* 39, 20-31.
- MDEQ. 1990. Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers, April 24, 1990. Revised June 1991, August 1996, January 1997, May 2002, and December 2008. http://www.michigan.gov/documents/deq/wb-sw-as-procedure51_280711_7.pdf
- MDEQ. 1997. A Strategic Environmental Quality Monitoring Program for Michigan's Surface Waters. January 1997. Report #MI/DEQ/SWQ-96/152.
- MDEQ. 2002a. Quality Assurance Project Plan Review Process - Great Lakes Environmental Assessment Section Procedure 88. May 2002.
- MDEQ. 2005a. Michigan Water Quality Monitoring Strategy Update. April 2005. Report #MI/DEQ/SWQ-05/082. http://www.michigan.gov/documents/deq/wb-sw-as-strategyupdate_254121_7.pdf
- MDEQ. 2005b. MDEQ Quality Management Plan (QMP). December 2, 2005. Revised July, 2008.
- MDEQ. 2012. Consolidated Report. An MDEQ Report on the: Environmental Protection Bond Fund, Cleanup and Redevelopment Fund, Clean Michigan Initiative Bond Fund As of September 30, 2012.
- MDEQ. 2013a. Qualitative Biological and Habitat Survey Protocols for Nonwadeable Rivers. Policy and Procedure #WRD-SWAS-022.
- MDEQ. 2013b. Michigan's Water Chemistry Monitoring Program. A Report of Statewide Spatial Patterns 2005-2009 and Fixed Station Status and Trends 1998-2008. February 2013. Revised February 22, 2013. Report #MI/DEQ/WRD-13/005.
- MDEQ. In preparation. Macroinvertebrate Community Status and Trend Monitoring Procedure.
- MDNR. 1982. Michigan Inland Lake Project: Identification, Survey and Classification. U.S. Environmental Protection Agency Clean Lake Agreement No. S 005511-01 Final Project Report, September 1982.
- MDNR, MDARD, U.S. Department of Agriculture, and Michigan State University. 1985. State of Michigan Phosphorus Reduction Strategy for the Michigan Portion of Lake Erie and Saginaw Bay.

- NOAA. 2011. National Center for Research on Aquatic invasive Species, Great Lakes Environmental Research Laboratory: *Great Lakes Aquatic Nonindigenous Species Information System* accessed May, 2011.
www.glerl.noaa.gov/res/Programs/glansis/glansis.html.
- Omernik, J. and A. Gallant. 1988. Ecoregions of the Upper Midwest States. USEPA, Envir. Res. Lab. Publication #EPA/600/3-88/037.
- Ontario Ministry of the Environment. 1993. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Prepared by: D. Persaud, R. Jaagumagi, and A. Hayton. Water Res. Br. OME. ISBN 0-7729-92-48-7.
- Pimentel, D., L. Lach, and R. Zuniga. 2000. Environmental and economic costs of nonindigenous species in the United States. *Biol Sci* 50:53–65.
- Ricciardi, A. 2006. Patterns of invasion in the Laurentian Great Lakes in relation to changes in vector activity. *Divers. Distrib.* 12, 425–433.
- Sommers, L.M. (ed). 1977. Atlas of Michigan. Michigan State University Press.
- Strum, M. 2000. Total Great Lakes Area and Michigan's Jurisdictional Area. Army Corps. of Engineers, Detroit Office, Great Lakes Hydraulics & Hydrology Unit.
- USEPA. 1997a. USGS Field Operation Plan: Tributary Monitoring. Lake Michigan Mass Balance Study Methods Compendium, Vol. 1: Sample Collection Techniques. EPA 905/R-97-012a.
- USEPA. 1997b. PCBs and Pesticides in Surface Water by XAD-2 Resin Extraction. Lake Michigan Mass Balance Study Methods Compendium, Vol. 2: Organic and Mercury Sample Analysis Techniques. EPA 905/R-97-012b.
- USEPA. 1999. 1999 Updated of Ambient Water Quality Criteria for Ammonia. Office of Water. EPA-822-R-99-014.
- USEPA. 2001. Water Quality Criterion for the Protection of Human Health: Methylmercury. Office of Science and Technology, Office of Water. EPA-823-R-01-001.
- USEPA. 2002. Consolidated Assessment and Listing Methodology: Toward a Compendium of Best Practices. Office of Wetlands, Oceans and Watersheds. July 2002.
- USEPA. 2006. Application of Elements of a State Water Monitoring and Assessment Program for Wetlands. Wetlands Division, Office of Wetlands, Oceans and Watersheds. April 2006.
- USEPA. 2011a. Great Lakes National Program Office Environmental Indicators, Trophic State of the Great Lakes. October 5, 2011.
<http://www.epa.gov/glnpo/glindicators/water/trophica.html>
- USEPA. 2011b. Saginaw River and Bay Area of Concern. October 5, 2011.
<http://www.epa.gov/glnpo/aoc/sagrivr.html>

USEPA. 2013. Great Lakes National Program Office, Great Lakes Areas of Concern.
November 25, 2011.
<http://www.epa.gov/glnpo/aoc/images/aoc-glbasin-map-20130215.pdf>

Walker, WW., Jr. B. 1979. Use of Hypolimnetic Oxygen Depletion Rate as a Trophic Stat Index for Lakes: Water Resources Research, v. 15, no. 6, p. 1463 – 1148.

Waples, J. T., and J. V. Klump. 2002. Biophysical Effects of a Decadal Shift in Summer Wind Direction over the Laurentian Great Lakes, Geophys. Res. Lett., 29(8), 1201, doi:10.1029/2001GL014.